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POLICY LEARNING AND POLICY CHANGE IN A CONTEXT OF INDUSTRY CRISIS: THE CASE OF CHILEAN SALMON FARMING INDUSTRY

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Policy Learning and Policy Change in a Context of Industry Crisis: The Case of Chilean Salmon Farming Industry

SUMMARY

This research investigates the policy response to the 2007-2010 sanitary crisis in the Chilean salmon industry, the second largest producer and exporter of salmon in the world. This industry is an emblematic case of the possible consequences of employing an intensive natural resource model for development.

The research draws upon the two literatures on policy learning and policy change, and crisis and disaster management, and upon the system failure to explain the causes and consequences of the sanitary crisis in the industry. The thesis employs the qualitative method of case study and utilises primary and secondary sources of data and information.

The main argument of the research is that the process of policy learning during and following catastrophic events is very different from the process of the policy learning during normal times. The main findings are, firstly, in the case of the Chilean salmon industry, the sanitary crisis disrupted the industry governance processes, including the regulatory framework of the industry, opening a window for radical institutional change. Secondly, potentially radical measures were part of a set of policies that emerged as initial responses, after which a set of more incremental policy responses were developed and applied. Moreover, the sanitary crisis was not transient nor episodic but was enduring, persistent and dynamic. Thirdly, the policy responses to the sanitary crisis destabilised the consensus in the Chilean industry causing conflict and ambiguity over policy responses.

The thesis contributes to the policy learning and policy change literature in the context of catastrophic events by extending the view this literature offers on dramatic events such as crises, by considering them as dynamic and persistent situations, analysing their potential as precipitators of radical policy change, and providing a means for considering the timing and processes by which this radical policy change may occur and be directed toward better social outcomes.

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CHAPTER 1

INTRODUCTION

This introductory chapter is organised in five sections. The first section explains the motivation of this research. Section 2 presents the research problems, whilst Section 3 poses the objective, framework, research method, methodology and data. The fourth section explains the argument of the research and main contribution to knowledge, and the final section outlines the structure of the thesis.

1.1. Motivation of the research

This research studies governance issues of a resource intensive biological production system. The central topic of this thesis is how actors respond to a natural resource industry crisis through the processes of learning linked to institutional change, with special reference to salmon farming in Chile. Salmon farming is an example of an intensive development of a biological production system that has offered an important opportunity for developing countries to develop export-oriented industries and commerce to generate economic development and social changes towards industrialisation. The governance of such industries is important because of their potential for causing ‘tragedies of commons’ (Hardin, 2009) due to overuse, degradation and externalities that arise from the intensive use of resources.

Existing literature has extensively considered mixtures of government-led and self-governance for resource intensive activities that cause the direct externality of overuse (e.g. Ostrom *et al*., 1999 and Feeny *et al*., 1990, studying common use resources by individuals who pursue their own interests but who are aware of the potential for collective externalities. The overuse of common resources is only one of the possible externalities associated with intensive biological production systems. Disease is an important externality that has received some attention especially in the aquaculture literature (e.g. Murray and Peeler, 2005 and Pizarro and Zolezzi, 2003, studying the development and transmission of diseases in intensive aquaculture systems). However, disease as an externality has not yet been examined in depth as a cause for governance reformation, for example, the setting of appropriate policies either by the actors in the system or by external authorities such as governments.

This thesis addresses a specific case in which governance reforms were undertaken in response to a specific crisis related to fish disease. Although the nature of this sanitary crisis and the measures taken were influenced by a variety of factors depending on the context, this analysis of the process of governance reform offers important lessons that may be translated into other contexts and constitute the foundation for generalisations from this thesis.

In Chile the origins of salmon culture go back to 1850 when there were some attempts to introduce exotic fish species into the country. Between that time and the early 1920s, several activities such as the import of salmon eggs, release of young fish in rivers in the south of the country, and the construction of fish pools were conducted. In 1921 governmental organisations took a more active role in the incipient activities of farmed salmon bringing Coho salmon (a type of Pacific salmon) eggs into Chile from the United States. This public initiative allowed the placing of fish in southern rivers; this later made sport fishing possible (Vera, 2010).

In the 1920s and 1930s there were attempts to introduce other salmon species into Chile, such as Chinook salmon and sockeye salmon, but without success (Achurra, 1995; Vera, 2010). In the 1940s the first successful production of Atlantic salmon and brown salmon eggs was achieved and further fish pools were built in the 1950s (Vera, 2010). In the late 1960s Chile obtained international cooperation from the Japanese International Cooperation Agency (JICA) to continue activities to introduce Coho salmon. This cooperation was focused on the technical and economic feasibility of salmon farming in Chile and human resource development to support those activities (United Nations, 2006). Between 1972 and 1981, as part of this cooperation programme between Japan and Chile, an attempt to introduce Pacific salmon into the country using the ranching system was made, but it did not work as was expected (Achurra, 1995). In the 1970s the initial development of the regulatory framework for the fishing sector was started. In 1976 the Undersecretary of Fishing and in 1978 the Fisheries Service were created, both under the authority of the Ministry of Economy.

In commercial terms, in 1974 the country built the first private commercial fish pool (Escobar, 2009). In the early 1980s the public-private organisation, Fundación Chile, made efforts in open system cultivation but it did not give positive results. Then, through research and development, Fundación Chile transferred and adapted the intensive salmon culture in cages system from European countries (e.g. Norway, Scotland) creating a firm. With the support of Fundación Chile, 1982 marked the beginning of the first firms to cultivate Pacific salmon, and in 1984 the first commercial harvest of Pacific salmon occurred (Escobar, 2009). The creation and supporting of firms by Fundación Chile opened up a new area of the Chilean economy. With this demonstration effect (i.e. to produce salmon that was commercially viable) private investment was encouraged to create similar firms in the incipient industry (Achurra, 1995).

Thus, the early stages of the industry were characterised by the development of technical feasibility of domestic production and technical knowledge through transfer, imitation and adaptation of technologies. Influenced by the ideology of the Entrepreneurial State[1], the Chilean government took the lead in conducting active actions and research for the introduction of the salmon fish into the country and development of the aquaculture sector.

Since the 1980s the strategy of an open, competitive and free-trade oriented economy was adopted by the country. The State's interests were concentrated on the development of non-traditional sectors to diversify the Chilean economy. With this intention the industrial initiation of salmon activities was a priority and the entry of Chile as a viable commercial salmon producer was developed by this strategy. Part of the strategy consisted of a vertical orientation policy aimed at developing commercial opportunities from comparative advantages that already existed in the country, and the policy was carried out by the semi-public organisation Fundación Chile (Achurra, 1995). This involved introducing an export-oriented model as part of the trade policy reforms that opened markets and supported the development of local capabilities for the Chilean salmon activities. New knowledge allowed the specialisation of firms and the development of related firms (i.e. supplier development). This led to the consolidation of an industry.

Public funds were spent to conduct research and development and continue with technological improvements. One of the major technological advances was the national production of eggs that gave national producers greater independence. In the same way, the greater efforts to expand into export markets led to the development of greater knowledge in areas of certification and improvement in other quality standards. As part of the aim to expand the industry, the State's interests were oriented to the attraction of investment and the exploration of new markets. In this effort, more regulation came to the sector, mainly to organise the functions of the institutions that supported the industry and make the institutional platform more efficient.

[1] According to Mazzucato (2011), an Entrepreneurial State is one that can be considered as a 'creator of the knowledge economy' (p.20). It is one that is targeted, proactive and takes risks to promote economic growth. Then, the ideology of the Entrepreneurial State can be understood as a set of ideas and beliefs based on the leading role of the State to promote economic growth through the development of an economic sector.

In 1989 the first General Law of Fishing and Aquaculture (Law N° 18892) to promote growth of aquaculture in the context of environmental sustainability was published. This law was complemented in the 2000s with regulation on environmental and sanitary areas. As a result, the Chilean salmon industry reached high productivity and profitability as well as a rapid insertion into the global economy. From experimental production to mass production, in 1992 Chile became the second larger producer and exporter of salmon in the world with a production of 23,715 tonnes of Atlantic salmon, 22,165 tonnes of Coho salmon and 15,515 tonnes of rainbow trout (Knapp, Roheim and Anderson, 2007; FAOSTAT).

The combination of comparative and competitive advantages explains the success of the Chilean salmon industry. Achurra (1995), Montero (2004) and Knapp, Roheim and Anderson (2007) discuss some of these advantages:

- a capacity of production on a large scale based on the access to an extensive and suitable natural resource water (extensive coastline with suitable sea sites, rivers and lakes in terms of topography, water temperature, salinity and luminosity) to perform the hatchery and fattening phases, easy access to fishmeal for salmon feed;
- low-cost skilled labour, entrepreneurial business initiative, collective organisation capacity to create the Association of Salmon Industry;
- favourable regulatory environment and public support, technological learning, development of supplier products and services, specialised human capital and logistic systems to ship products;
- minimum interference with other fishing activities (i.e. commercial and recreational) to develop salmon farming activities;
- little pressure from environmental groups;
- permanent promotion of markets and efforts aimed at meeting the preferences of customers (i.e. provide high quality products in attractive and convenient formats); and
- the possibility of supplying markets with fresh products in the opposite season to those salmon industries located in the northern hemisphere, since Chile is located in the southern hemisphere and its seasons are opposite to those of the northern hemisphere.

The features of industry development with a historical intensive production system characterised by high concentration and density, which means overcrowding of fish in farming cages as well as farming centres in a territory, has provoked the development of diseases with the critical point being the onset of a sanitary crisis that affected the industry in 2007. The crisis was caused by Infectious Salmon Anaemia (hereafter ISA), an exotic disease that became endemic in the industry and required governance response.

The principal questions of this thesis arise from the examination of that governance response to this crisis, an analysis that requires looking at both actors' interests and policymaking processes. The thesis examines the period between 2007 and 2013, i.e. from the onset of the sanitary crisis until the time when the consequences of the governance response can be examined. It considers a variety of actors involved in the production of salmon such as the industry (producers and suppliers), the government, several associations, non-governmental organisations (hereafter NGOs), knowledge providers and banking sector, to name but a few.

1.2. Research problem: policy responses through policy learning and policy change processes precipitated by a sanitary crisis in the Chilean salmon farming industry

In 2007 the Infectious Salmon Anaemia virus (hereafter ISAv), a biological agent that kills salmon, was introduced into the Chilean salmon farming industry and since then the industry has become chronically vulnerable to further outbreaks of the disease. The virus rapidly spread throughout the industry and became an epizootic (widespread outbreaks) causing a sanitary crisis in the industry that was followed by a financial and social crisis.

This sanitary crisis was, in part, a negative externality of the overexploitation of the natural common pool resource water; however, the conditions that explain the origins of the crisis are diverse and interdependent suggesting a systemic failure in the industry. The history of the Chilean salmon industry is a clear example of how the modern tendency of development in natural resource-based industries was successfully achieved. At the same time, it reveals the perils that arise when that success has been achieved at the expense of the overuse of a natural common pool resource, alongside a poor management of ecological conditions.

The sanitary crisis in the industry renewed the historical conflict between environmentalists and the industry, and between the environmentalists and the government, and at the same time precipitated a process of policy learning and policy change. Industry and government reacted to the crisis and responses were applied in two phases. The short-term policy responses were potentially radical and aimed at attending to the contingency of fish mortality due to the virus and stop the epizootic. The long-term responses were more incremental and aimed at updating the industry's regulatory framework to include a more preventive approach, to develop and implement new policies, as well as modifying existing policy instruments to deal with ISAv and its effects.

The sanitary crisis was a turning point in the industry trajectory suggesting that a more sustainable approach in policy through an ecological view was needed, as opposed to the neoliberal approach taken by the industry and the government. With a sustainable-oriented discourse the crisis became the policy window for reforming the industry regulatory framework. The permanent conflict among environmentalists, industry and government during the process of policy reform and the evolutionary stages of the sanitary crisis became the main sources in influencing the progress of those reforms.

The responses to the sanitary crisis caused different consequences in the short and long term for a variety of industry actors and society. The short-term consequences were related to the problems in introducing the new regulatory framework into practice, and the conflict and ambiguity generated by the design and delivery of the potentially radical policy responses developed in the first stages of the crisis. The long-term consequences were related to the adjustment of policy responses with an attempt at reducing the conflict and ambiguity among actors and make the responses politically and technically feasible.

1.3. Objective, framework, research method, methodology and data of the research

This research analyses the learning and change in policies in response to catastrophic events. Specifically, it analyses the policy responses in the Chilean salmon farming industry during the period 2007-2013 caused by an industry sanitary crisis. An important aspect of this analysis is to examine and explain whether those responses produced radical or incremental changes in policy.

Section 1.1 has explained the motivation of this study and briefly reviewed the context of the development of the industry as a background to the thesis. From that account three research questions have emerged that will be examined in the context of the Chilean salmon industry. Firstly, how do industry natural resource crises precipitate processes of policy learning and policy change? Secondly, how are policy responses stimulated by industry natural resource crises developed and implemented? Finally, what are the consequences of policy responses stimulated by industry natural resource crises for industry participants and society (e.g. local environment and jobs)?

An overarching argument of this thesis is that, in the context of catastrophic events, the process of policy learning is very different from the process of policy learning during normal times. In the literature of policy learning and policy change, catastrophic events such as crises are viewed as transient disturbances or episodic events: they are viewed as 'focusing events' (Kingdon, 2003). This research categorises this as the view taken during normal times. The comparison of policy learning during normal times, and policy learning in the context of catastrophic events, is made by examining and explaining whether the sanitary crisis of the Chilean salmon industry was a transient disturbance or episodic event as the literature views.

The framework of this research draws upon literature on policy learning (Heclo, 1974; Sabatier, 1988; Rose, 1991; May, 1992; Hall, 1993), policy change (May, 1992; Bennett and Howlett, 1992; Hall, 1993; Kingdon, 2003), and crisis and disaster management (Faulkner, 2001; Quarantelli, 2006). Insights from the system of innovation literature, particularly the system failure approach (Woolthuis, Lankhuizen and Gilsing, 2005), offer some useful guidance for explaining the causes of the sanitary crisis. However, this theory is found to be incomplete because it does not consider the role of unexpected factors, which in natural resource industries and industries working with biological systems such as aquaculture and salmon, constitutes a crucial aspect in policy making. The role of 'unexpected factors' is incorporated into the system failure approach for the purposes of this research, as explained further in Chapter 2.

The research questions posed above propose that the policymaking process needs to be examined in relation to the precipitating effect of the crisis, the short and long term policy responses to the crisis, and the consequences that those responses caused. This suggests that the research questions are established in time in three phases of observations. Each of these phases draws upon a distinct policy studies theoretical literature.

In the first phase, using an adaptation of the system failure approach (Woolthuis, Lankhuizen and Gilsing, 2005) and causal stories (Stone, 1989), a characterisation and diagnosis of the Chilean salmon industry was conducted to understand the nature of the crisis and its relationship with the structural characteristics of the industry at the time of the crisis. In the second phase, the policy responses to the crisis were analysed using a policy learning and policy change approach (Hall, 1993; May, 1992; Kingdon, 2003) in order to explain how a policy learning process in the industry was precipitated by the crisis and how the responses were developed and applied. Finally, in the third stage the consequences of the policy responses to the crisis were analysed from a 'conflict and ambiguity' perspective. In this perspective, conflict emerges from inconsistent views that actors have when more than one actor sees a policy as directly relevant to his interests, whilst ambiguity occurs when there is misunderstanding in policy goals or roles of bureaucrats, as well as uncertainty in the resources to perform the activities to implement the policy (Matland, 1995).

The reason for selecting different theories related to policymaking processes for each of the phases is that the empirical findings make more sense when they are interpreted using the different theories. Different theories were needed because, as the phases progress, new elements or processes were emerging in the policymaking process and there were also consequences in the way in which the policymaking process was conducted. To address these elements or processes, an historical approach of the policymaking process and the role of actors having interests in the outcomes of these processes will be employed.

This design (explained more fully in Chapter 4) takes policies at the industry level as the main unit of analysis, and disagreements or incompatibility of interests, values and understandings among actors over policy issues as the main unit of observation. It applied a longitudinal design to observe the dynamic and evolution of policies in terms of their development and delivery. The primary source data was gathered from the interviews conducted with a complete set of industry actors. This was complemented with secondary data such as reports from governmental institutions, associations and firms, newspapers, enacted laws and records of parliamentary processes to passage of these laws.

1.4. Argument of the thesis and main contribution to knowledge

This thesis argues that the process of policy learning in the context of catastrophic events is very different from the process of policy learning during normal times. Catastrophic events that are enduring, persistent and dynamic disrupt governance processes; they open policy windows for potential radical changes in which new actors and new ideas emerge. The argument is demonstrated using the case of the Chilean salmon farming industry where a sanitary crisis precipitated policy learning and policy change processes, stimulating an opportunity for radical and incremental changes in industrial policy.

This thesis makes its main theoretical contribution to the literature of policy learning and policy change. It extends this literature in considering catastrophic events as dynamic situations as opposed to stagnant events as the literature treats them. The dynamic of the catastrophic events creates a pattern for dynamic policy learning and policy change.

In more general terms, and connecting with the motivation of the thesis, it is possible to say that catastrophic events such as crises are particular examples of the consequences of intensive exploitation of biological production systems. It was not thought by the actors involved that a consequence of intensive exploitation of such systems could cause a crisis. This suggests that if these sorts of issues can be addressed, crises can be anticipated, avoided or limited in their extent. Thus, examining and learning about the role of crises as this research does also contributes to the discussion of potential crises, crisis anticipation and ways to avert crises.

1.5. Structure of the thesis

This thesis is composed of eight chapters. **Chapter 1** is the introduction that presents the motivation of the research, the research problem, the objective of the research with a summary of the framework, research design, methodology and data employed, the argument of the thesis, its contribution to knowledge and structure. The theoretical discussion is mainly focused on the policy learning and policy change processes stimulated by catastrophic events.

Chapter 2 considers catastrophic events as dynamic, persistent and enduring situations that challenge the assumptions adopted by the policy learning and policy change literature in which catastrophic events are viewed as transient disturbances or focusing events. The case of the sanitary crisis in the Chilean salmon farming industry, which made the industry vulnerable after the introduction of the ISA virus, developed over time (i.e. it was not transient) and provided multiple stimuli (and responses) to policy change (i.e. it provided multiple foci). This sanitary crisis represents a specific crisis that was not new in the world.

Chapter 3 presents the background of the infectious salmon anaemia, the context of the sanitary crisis in Chile and the impacts of this disease on the local industry.

Chapter 4 develops the research design and methodology to answer the research questions. It also justifies the case study as the research method of this thesis, explains the selection of the case study and the organisation of the context, and discusses the reliability, validity and generalisability in qualitative research. It also presents the sources of data and information, and the methods by which the data and information was collected and analysed.

Chapter 5 is the first analytical chapter. It analyses how the sanitary crisis of the Chilean salmon farming industry became the policy window to reform industry regulations and precipitated the industry policy learning process. It offers an explanation about causes of the crisis from a system failure perspective. Evidence shows that the crisis in the industry cannot be assigned to just one direct cause. There were interdependent conditions corresponding to different categories that together contributed to the emergence of this crisis. This constitutes an alternative explanation from those provided in the literature.

Chapter 6 is the second analytical chapter and analyses the short and long term policy responses to the sanitary crisis for the Chilean salmon industry. It examines the incremental and potentially radical measures, and discusses whether the measures taken to respond to the crisis produced a radical policy change.

Chapter 7 is the last analytical chapter and analyses the consequences of the policy responses to the industry sanitary crisis from a conflict and ambiguity perspective. Moreover, it discusses the evidence of industry policy learning and policy change and the closing of the policy window that was opened by the sanitary crisis.

Chapter 8 is the final chapter of the thesis and concludes by revisiting the motivation for the research and summarising the theoretical, methodological and empirical contributions of this research to knowledge, and outlining some limitations and possible future work.

CHAPTER 2

POLICY LEARNING AND POLICY CHANGE IN THE CONTEXT OF CATASTROPHIC EVENTS

"We can think of policymaking as a process that usually involves three central variables: the overarching goals that guide policy in a particular field, the techniques or policy instruments used to attain those goals, and the precise settings of these instruments"
(Hall, 1993 p278)

As mentioned in the introductory chapter, this research contributes to the policy learning literature and is concerned with how actors respond to an industry natural resource crisis through the processes of learning linked to institutional change. The questions that guide this research are the role of natural resource industry crises as policy learning and policy change precipitators, the development and implementation of policy responses triggered by those crises, and the consequences of those policy responses for industry participants and society. To answer these research questions, this chapter introduces "policy learning" and "policy change", and "crises and disasters management" literatures. It argues that these literatures provide a rich theoretical lens through which to study processes of learning in policies following industry crises provoked by natural resource crises, and sanitary crises in particular.

Some of the policy learning and policy change literature has been framed as a response to catastrophic events, variously termed as catastrophes, crises and disasters (Birkland, 2006; Farley *et al*., 2007; Howlett, Ramesh and Perl, 2009; Keeler, 1993; Kingdon, 2003). However, it has a limited view of these situations, considering them as focusing events that are transient or episodic disturbances. This view does not take into account that catastrophic events may evolve and create dynamic processes of policy learning and policy change. On the other hand, although the existing literature on policy learning and policy change does refer to radical policy change and the potential of catastrophic events as accelerators of radical policy change, it does not analyse in detail the timing or steps by which radical policy change is likely to occur after a dramatic event. As a result, we still lack a deeper understanding of policy learning and policy change stimulated by dramatic events; this is because the literature on policy windows and the processes of policy learning and policy change they trigger still remain as a black box.

This research attempts to fill these gaps by analysing the evolution of crises and the dynamic they create for policy learning and policy change processes, specifically radical and incremental changes. The research provides and adds a deep analysis of radical and incremental policy changes stimulated by crises. To do so, this study bridges the policy learning and policy change literature with the literature related to crises and disasters management. This draws upon the policy learning and policy change literature (May, 1992; Hall, 1993; Kingdon, 2003) and partly on a broader literature relating to crises and disasters management (Faulkner, 2001). This research argues that, due to the nature of the policy window that crises open, the process of policy learning in the context of crises is very different from the process of policy learning in their absence.

The research uses the term crisis instead of disaster or catastrophe because, as Faulkner (2001) discusses, crises are events induced by the actions or inactions of organisations. This term considers the role of human action where involved actors have some control. Fieldwork conducted for this research revealed that the role of the human action over the untoward event experienced by the Chilean salmon farming industry was crucial in understanding its causes where involved actors had some control over the development of the conditions that stimulated the event.

This research refers to a crisis as 'an event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures' (Carter, 1991 quoted in Faulkner, 2001, p.138). Although this is Carter's definition of disaster, it may be applied to crises since the definition considers all the relevant aspects of catastrophic events equally if they are called crises, disasters or catastrophes that according to Faulkner (2001) are needed to identify and respond to them. Also, Faulkner (2001) says that the characteristics of disasters may be equally applied to crises.

The first section of the chapter presents the definition of sanitary crisis that this research will employ, highlighting the features of natural resource industry crises. Then the chapter turns to the role of crises as focusing events and policy window as the main theme of the second section. It is followed by the third section that analyses the role of crises in precipitating processes of policy learning and policy change, and in creating opportunities for radical policy change. The fourth section discusses traditional explanations of the origins of natural resource crises, and, in addition to a discussion, provides an alternative explanation on how they create the basis for policy responses.

Crises stimulate policy responses, and the fifth part of the chapter analyses this process classifying them into short and long term responses. Responses to crises cause consequences that can also be analysed in the short and long term; the sixth section refers to this. The seventh section of the chapter examines evidence of policy learning and policy change after crises and the closing of policy windows opened by catastrophic events. The last part of the chapter re-states the research questions to be answered in this thesis.

2.1. Sanitary crisis as a type of industry natural resource crisis

This section helps to answer the first research question on how industry natural resource crises precipitate policy learning and policy change by defining a specific type of natural resource industry crisis, a sanitary crisis. According to the World Health Organisation (WHO) sanitation 'refers to the maintenance of hygienic conditions' (World Health Organisation, 2014b) and 'hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases' (World Health Organisation, 2014a). Thus, diseases result from poor sanitation and unhygienic conditions.

For fish, including salmon, the Food and Agriculture Organization of the United Nations (FAO) points out that 'the production of safe and quality fish and fishery products requires effective hygienic practices throughout the food chain. Hygienic measures are aimed at preventing or reducing fish contamination and microbial growth and in this way the development and dissemination of diseases' (Food and Agriculture Organization of the United Nations, 2014).

This research employs a sanitary crisis in the context of salmon farming as the type of industry natural resource crisis to be further examined. The natural resource involved in this particular type of crisis corresponds to the common-pool resource (CPR) 'water'. Adapting the definition of crisis employed by this research (see p.23) to fish sanitation and hygienic settings, this thesis refers to a salmon sanitary crisis as '*an event, natural or man-made, sudden or progressive, which impacts hygienic conditions attempting against health and facilitating the development and spread of diseases with such severity that the affected community has to respond by taking exceptional measures'*. In this case the 'affected community' may refer to humans, salmon or other living entities linked to the salmon industry. However, since this research employs the sanitary crisis of the Chilean salmon farming industry caused by the infestation of farmed salmon with ISAv as the case study, the affected community that had to respond to the outbreaks and spread of the ISAv corresponds to the actors related to the salmon farming industry (e.g. industry and government), although the salmon itself is the affected community in the first place. The possibility of humans affected by ISAv as 'affected community' has been discarded, since ISAv does not infect human beings (European Commission, 2000).

The sanitary crisis of the Chilean salmon industry accounts for the negative externalities associated with the intensive use of natural common-pool resources, in this case, water. Although salmon farming involves the insertion of human artefacts (pens and nets) into the natural environment water, it does not isolate the salmon from there. This is the feature that makes the disease ISA endemic and raises the more general issues concerning externalities. This research documents this disease crisis as another example of negative environmental externalities related to intensive natural resource use, but also as an example of negative biological externalities linked to this intensive exploitation. As will be seen later in Chapter 7, the theoretical consequences of these biological externalities will have policy implications that will derive insights for the policy learning and policy change literature.

Biological externalities are the effects that two or more species in an area have on each other. This is based on the ecological fact that the existence of species has effects on the development of other species. A positive biological externality occurs when a species provides something that benefits other species. On the other hand, a negative biological externality occurs when a species harms other species (Tullock, 1971). In ecological terms the appearance of a disease is understood by the breakdown of the ecological triad, which is the relationship of the host, pathogen and environment (Hedrik, 1998). In this view biological externalities are seen as the effects of the host, pathogen and environment on each other. Chapter 5 analyses these biological externalities through an ecological policy paradigm lens. Chapters 6 and 7 will discuss the policy implications of biological externalities in the Chilean salmon industry.

The following table shows the possible negative biological externalities between host, pathogen and environment. It contributes to the argument on the different effects that pathogens may have on different hosts. Policy responses to sanitary crises that do not take these differences into account will be contested and ineffective, such as those in the Chilean salmon industry (see Chapters 6 and 7).

In the disease crisis of the Chilean industry there was a set of negative biological externalities between pathogens, hosts and environment. Although the pathogen that caused the crisis was identified as the ISA virus, it was also demonstrated that the sea lice caligus acted as a vector of the virus. The virus and the sea lice affect the three species of salmon that are mainly commercialised in Chile (Atlantic salmon, Coho salmon and rainbow trout) differently, and they also had an effect on the environment water.

Table 2.1: Biological externalities between pathogen, host and environment

	Who receives the externality		
Who produces the externality	**Pathogen**	**Host**	**Environment**
Pathogen	The effects of a pathogen on other pathogens are negative and unknown A pathogen can act as a vector of other pathogens	The pathogen may infect the host and make it sick The pathogen may infect the host but not make it sick	The pathogen contaminates the environment
Host	The host may reproduce the pathogen The host may act as a vector of the pathogen	The host may transmit the pathogen to other hosts	The host may release the pathogen into the environment and contaminates it
Environment	The environment disseminates the pathogen	The environment acts as a mechanism of pathogen transmission to a host	The environment disseminates pathogens to the environment

Source: Own elaboration based on Nylund, Wallace and Hovland (1993), Nylund *et al*. (1997; 2003), Jarp and Karlsen (1997), Murray, Smith and Stagg (2002), Stagg (2003), McVicar (2003) and Rolland and Winton (2003).

Summary:

This section has defined what this research understands by a sanitary crisis. It has been pointed out that this type of natural resource industry crisis impacts the hygiene of industries through the development and spread of diseases, in the case of this research, the spread of ISAv in the Chilean salmon industry. Industry and government actors are the affected community that has to respond to the crisis by taking exceptional measures. However, how crises start to be considered as a problem to be faced by those actors is an open question and the topic of the next section.

2.2. The role of crises to policy learning and policy change

In the policy learning and policy change literature, the study of Kingdon (2003) on agenda setting in the United States analyses how problems capture the attention of policy makers, why policy makers take notice of some subjects and not others, and why some items rise while others fall on their agendas. He found that sometimes problems are not self-evident for governmental officials including policy makers, and that they need a 'push' to get the attention of people in and around the government. One mechanism that gives this 'push' are what he calls ‘focusing events’. These are events that take the attention of people in and around the government and raise the issue in the governmental decision agenda, prioritising it on the agenda. He specifies that crises are powerful focusing events.

Based on the work of Kingdon, Birkland (2006) analyses a series of catastrophic events and how policy follows them. Referring to focusing events he explains that ‘a disaster can often do in an instant what years of interest group activity, policy entrepreneurship, advocacy, lobbying, and research may not be able to do: elevate an issue on the agenda to a place where it is taken seriously in one or more policy domains’ (p.5). Thus, in the policy learning literature, focusing events such as crises have a transitory effect; they last a relatively short time and, at their onset, rapidly seize the attention of government officials and people around the government; they are events that demand immediate attention and about which something should be done.

According to Birkland (2006) focusing events such as crises attract attention because they provide evidence of policy failure. A direct, but not entirely satisfactory way of resolving what the response to such failure might be is to view crises as policy windows. Defined by Kingdon (2003), policy windows provide ‘an opportunity for advocates of proposals to push their pet solutions, or to push attention to their special problems’, or in other words they become ‘opportunities for action on given initiatives’ (Kingdon, 2003 p.165-166). Kingdon (2003) argues that major changes in policy occur when those opportunities are present, and that these policy windows are usually unpredictable because no one knows when a crisis may come. As Kingdon (2003) says ‘the timing of the crisis is uncontrollable and only partially predictable’ (p.190). Moreover, the window opening is uncertain and if there are no solutions or political support to address the defined policy problem the window rapidly closes (Kingdon, 2003). Considering this, we may say that industry natural resource crises abruptly open the policy window, since the crisis itself, and the failures revealed by the crisis, suddenly take the attention of government officials who decide to do something about it.

On the other hand in the crises and disasters management literature, Faulkner (2001) states that crises usually have a negative connotation. In a common use of the concept it is related to danger, difficulty, problem, bad situation, damage and failure (Oxford Learner’s Dictionaries, 2014). However, he also states that crises may also have a positive potential, and they can be considered as turning points or opportunities as well as stimuli to innovations. Policy learning and policy change literature may take this view and consider that crises may be good opportunities for policy change and policy innovation. Indeed, if a crisis serves to reveal practices that were inherently unsustainable or risky, its occurrence may prevent even larger losses from the continuation of such risky or unsustainable behaviour. This research examines the sanitary crisis of the Chilean salmon farming industry as a turning point and good opportunity for a radical industry policy change.

Birkland (2006) argues that crises are likely to build gradually over time (as opposed to disasters that are mostly sudden). This argument is based on the belief that prior to crises it is possible to detect indicators or signals of the problem, even if no action is immediately taken. Deutsch (1966), May (1992) and Kingdon (2003) discuss the role of feedback and indicators in policy, indicating that usually this is the way by which government officials and policy makers are informed about certain problems. In the case of crises we may find the same: frequently some time before crises occur, different actors provide feedback and indicators to government officials and policy makers about problems related to the crises. As Kingdon (2003) explains, policy-makers and government officials recurrently receive feedback that may be systematic and formal, by way of studies or reports, or more informal, by way of complaints, denunciations and caseworks. Moreover, the experience of bureaucrats is also an important source of feedback for government officials. However, in the case of crises, even when different actors are permanently providing feedback and indicators on failures linked to those crises, many times this is not enough to take the attention of policy makers and place those issues on the governmental decision agenda (i.e. issues to be faced by policy makers).

According to Kingdon (2003) indicators and signals are subject to interpretation, and different actors may interpret the same indictors and signals in different ways. This may add ambiguity to the process of identifying crises. At the end, it is the interpretation of data and signals that actually transform feedback from conditions to problems to be faced by policy makers (i.e. policy problems). Birkland (2006) explains that whether an event is defined as crisis is a matter of how the relevant actors interpret that event, their indicators and signals, and whether these events are defined as policy problems. Interpretation of signals and ambiguity in diagnosing crises may be crucial in the timing of planning and developing policy responses to address those events. Indicators and signals that are interpreted early as warnings of coming catastrophic events might help to prevent, address early, or reduce the magnitude of those situations.

In the definition of crisis used by this research (see page 23), the ‘progressive’ aspect of crises allows for the interpretative facet in defining them as policy problems, including the possibility of dismissing (deliberately or unintentionally) indicators, signals and feedback that may prove that a crisis is occurring or will occur. A long time before the emergency of the sanitary crisis in the Chilean salmon industry, NGOs were giving feedback about the poor environmental and sanitary conditions in which the industry was operating. How this feedback was received by government officials is an issue that will be seen in Chapter 5.

An important aspect of disasters highlighted by Quarantelli (2006), which may also apply to crises, is their feature to be qualitatively and quantitatively different from routine emergencies. In crises, actors must be quickly mobilised and sometimes they need to connect with other (familiar and unfamiliar) entities; a convergence of actors in crises is required. There is a loss of autonomy or freedom of actions of some actors (for example the private sector may be required to follow the actions proposed by the government). Crises require the application of different rules, such as faster responses, and it is likely to observe a closer relationship between the public and private sectors.

The conceptual framework of this research involves the mobilisation of different local actors (e.g. industry and government) and their connection with other national and international entities (e.g. the Canadian salmon farming industry), the restriction of the industry in producing salmon, the development of different and additional measures, and the partnership between the industry and the government. Chapter 6 discusses these issues for the Chilean salmon case as part of the analysis of policy responses development to address its sanitary crisis.

Essential characteristics of crises are mentioned by Faulkner (2001, p.138) based on the studies of Wiener and Kahn (1972), Fink (1986) and Keown-McMullan (1997). Applying this to the Chilean salmon crisis context, the following table shows some of the characteristics that will be further examined in this research.

Table 2.2: Characteristics of crises

Characteristics of crises (Faulkner, 2001 p.138)	Some characteristics of the sanitary crisis in the Chilean salmon industry
The need to take exceptional measures referring to non-routine responses	The development and implementation of measures aimed at controlling the ISA virus
The creation of stress due to the suddenness of the change	Concern for the sudden high level of salmon mortality in the industry
The pressure on adaptive capabilities	The pressure of the industry on adapting to the new scenario after ISA crisis
A triggering event, which is so significant that it challenges the existing structure, routine operations or survival of the organisation	The opportunity to challenge the established policy paradigm and regulatory framework of the industry
High threat, short decision time and an element of surprise and urgency	The urgency in stopping the epizootic[2] caused by ISAv involving the short time to decide what to do and how to do it
A perception of an inability to cope among those directly affected	The potential perception of an inability of the government to impose rules to producers to stop the epizootic
A turning point, when decisive change, which may have both positive and negative connotations, is imminent	The turning point in the industry for a policy change
Characterised by fluid, unstable and dynamic situations	The potential for dynamic conflict and ambiguity over policy issues

Source: Own elaboration based on Faulkner (2001, p.138).

The characteristics of crises posed in the above table have implications for the policy learning and policy change literature. Those implications, as will be discussed later, are related to the type of policy response that dramatic events trigger. We argue that more radical or potentially radical responses are linked to urgent responses, exceptional and non-routine measures, the challenge of existing structures and turning points as the time in which crucial changes may take place.

Summary:

This section has explained two roles of crises to policy learning and policy change. Crises play a role as focusing events, seizing the attention of policy-makers and elevating the issue in the governmental decision agenda, and crises play a role as policy windows providing opportunities to push attention on specific problems. The next section will take forward the idea of focusing events and policy windows to begin constructing a framework for

[2] 'An outbreak of disease affecting many animals of one kind at the same time. It is the analogous term 'epidemic' which is applied to human populations' (http://www.merriam-webster.com/dictionary/epizootic Last accessed: 2 March 2014).

understanding how industry natural resource crises accelerate policy learning and policy change processes (first research question).

2.3. Policy learning and policy change from crises

The last section put forward the notion that crises act as focusing events and policy windows, also that they are sudden events that require non-routine responses or exceptional measures and decisive changes to deal with them. This reflection can be extended to industry natural resource crises and it can be said that these events push decisive changes at the policy level that challenge existing structures and routines. When the crisis comes, and if there is a policy ready to respond to the crisis (that policy should have been developed before the crisis comes), the policy is implemented without delay. However, if there is no policy ready to deal with it, natural resource crises push sudden changes in policies to deal with the crisis and correct the failures revealed by it. Like policy change stimulated by natural resource crises, policy learning processes may also be precipitated by those crises because when there is no policy ready, relevant actors start a process in which they search for knowledge and information to formulate that policy. May (1992) states that changes in policies providing evidence of policy failure require social and/or instrumental policy learning involving an understanding of the social construction of the problems to be faced by policymakers and an understanding of the policy instruments.

Policy learning and policy change is a body of literature interested in addressing a specific set of problems related to how policies change and adapt overtime through processes of knowledge accumulation. Sabatier (1993) and Sanz (1995) highlight that changes in policy reflect the accumulation of knowledge from the interaction, interdependence and participation of different actors. This course of knowledge accumulation is part of a collective learning process to which, following Heclo (1974), we may refer to as policy learning.

There is no a single definition or conceptualisation of policy learning. May (1992) indicates that in the policy literature it is said that the discussion on policy learning began with the work of Karl Deutsch (1966) on ‘the role of feedback in enhancing governmental learning capacity’ (p.332). Based on Deutsch’s work, Hugh Heclo (1974) defined and studied the political learning and social learning examining the social politics in Britain and Sweden. Since then policy learning concepts have emerged within the policy literature to challenge conflict and power theories in explaining policy making processes, as indicated by Bennett and Howlett (1992).

Without neglecting the role of the power in making policies, Heclo (1974) observed that policies are the result of a process of learning from political interaction, and that policy development processes were not just stimulated for power relationships but also from a variety of triggers outside the power domain.

The concept of policy learning has evolved since then, and there is no a single conceptualisation of policy learning. These conceptualisations have led to different understandings of what policy learning means, and consequently to define different types of policy learning. Because of this, and as noted by Bennett and Howlett (1992), there are several different explanations of policy change based on these different conceptualisations of policy learning. Bennett and Howlett (1992) and Birkland (2006) state that the four key conceptualisations of policy learning are political learning (works of Hugh Heclo and Peter May), lesson drawing (works of Richard Rose and some work of Hugh Heclo), social learning (works of Peter Hall, Paul Sabatier, Peter May and some work of Hugh Heclo), and government learning (works of Lloyd Etheredge). So, in the literature, policy learning means different things but when this research uses it, it means social policy learning in the conceptualisation made by Peter Hall, and complemented with the works of Paul Sabatier and Peter May as explained below.

An important premise of the policy and policy learning literature is that these processes of learning occur consciously and intentionally rather than by accident (as named in other literatures as muddling through). These constitute, as Hall (1993) indicates, 'a deliberate attempt to adjust the goals or techniques of policy in response to past experience and new information' (p.278). For Hall, changes in policies are the result of processes of learning and they may occur at three levels. The first, and simplest, policy change refers to changes in the setting of the policy instruments. At the second level, changes are made in the policy instruments, whilst more radical changes are said to occur at the level of the goals guiding policy (shift in the policy paradigm as will be explained later). However, unlike Hall, in policy windows opened by crises, these adjustments respond directly to the crises and more indirectly to past experience and new information. Policy responds to the crisis in the first place.

Hall (1993) explains that one of the principal factors affecting policy is past policy. He exemplifies this by saying that 'policy responds less directly to social and economic conditions than it does to the consequences of past policy' (Hall, 1993, p.277). However, considering crises as an intervening variable between policy learning and policy change, we may say that, in crises, policy responds less directly (or indirectly) to past policy, or consequences of past policy, and directly to the crisis. For example, in the case of the Chilean salmon industry, we argue that the policy responded less directly to the industry's social, sanitary and environmental conditions than it did to the crisis, as will be investigated in this research. When the crisis provided evidence of policy failure then the policy responded to the consequences of past policy. We argue that had the sanitary crisis not happened, it is unlikely that policy would have changed in the way it has.

Therefore, this research employs an adapted definition of Hall's policy learning as 'a deliberate attempt to adjust the goals or techniques or instruments or establish new goals and create new techniques of policy in direct response to external dramatic events like crises and indirectly to past experience and new information'. This adaptation is made considering that, in the case of the Chilean salmon industry, the policy responded directly to the sanitary crisis (an external event) and indirectly to the past experience of the industry.

Another dimension that Hall (1993) explores in his study of policy learning is the role of the actors in pushing forward the learning process. He criticises the conventional model of social policy learning in this respect since this model states that the experts in a given field policy are the key agent mobilising and/or influencing the process of learning. According to Hall, '[the state theorists' model] tends to downgrade the role of politicians in social learning and to attribute particular importance to the officials or experts who specialise in specific fields of policy' (p.277). However, neither the conventional model of social policy learning criticised by Hall, nor Hall's model of social policy learning, take into account the role of other "actors", different from experts and politicians, pushing forward policy learning processes.

As argued in Section 2.2, in crises, a closer relationship is likely to exist between the public and private sectors. This suggests that, like the public sector (e.g. politicians and bureaucrats), the private sector may also play a very active role in making policy and pushing forward the learning process; this is because they may provide valuable evidence on, for example, the technical and political feasibility of policy responses. Also NGOs, researchers and consultants, to name but a few, may also play an important role in pushing forward policy learning.

In terms of the autonomy of the state from outside factors such as societal pressures, Hall (1993) mentions that 'Heclo rejects the view that outside factors, such as socioeconomic development, elections, political parties, and organised interests, play a primary role in the development of social policy' (p.278). However, as we will see later in Chapter 5, in the case of the sanitary crisis of the Chilean industry it was precisely an outside factor (i.e. the crisis) that played the primary role in developing policy since the policy reacted to it.

In the policy learning and policy change literature, several authors have referred to different facets of crises and the relationship between these facets and institutional changes. The following account introduces some approaches to crises from a constructivist perspective and the role of narratives in interpreting crises (Widmaier, Blyth and Seabroke, 2007; Hay, 2013; Boin, t Hart and McConnell, 2009; Kern, Kuzemko and Mitchell, 2014; Birkland, 2006; Farley *et al*., 2007), the role of ideas in policy change related to crises (Menahem, 2008; Nohrstedt and Weible, 2010; Penning-Rowsell, Johnson and Tunstall, 2006), and how crises provoke a paradigm shift (Walgrave and Varone, 2008; Boin, t Hart and McConnell, 2009; Wilson, 2000).

From a constructivist approach and the role of narratives in interpreting crises, Widmaier, Blyth and Seabroke (2007) discuss the meaning of wars and crises as constructed meanings for changes in policy. They argue that wars and crises do not occur in a context free of interpretation. Exogenous shocks (such as wars and crises) are endogenous constructions shaped by the interpretation of what actors understand a crisis to be. In this interpretation framework, actors compete with each other to convince and persuade the meaning of a crisis and what should be done when a crisis arises. Positions of actors and their interests are part of this context. Hay (2013) also notes that 'crises are, in effect, what we make of them; and what we make of them determines how we respond' (Hay, 2013, p.23).

Boin, t Hart and McConnell (2009) discuss how actors exploit the opportunity the crises offer to change policies in their aftermath. They argue that when a crisis occurs, different frames contest with each other in explaining the origins of the crisis and the actions to be taken. The framing of this contest explains the policy outcomes from crises. The authors explain that actors fight to have their frame accepted and, in this way, to position their narrative as dominant. Actors exploit the disruptions of the governance made by the crisis to defend their beliefs and to have a better position over authority; thus putting forward new policies. The dominant narrative may imply either significant or minor changes in policies.

Kern, Kuzemko and Mitchell (2014) state that narratives (which are coming from ideas) play a role in shaping the existence of a crisis, the perception of actors about a crisis, how policy fails in solving a crisis, and the proposals put forward to solve the crisis. From the work of Hall (1993), the authors propose a framework for analysing a paradigm shift and explaining, from a more constructivist approach, how and why policy change takes place. Their explanation of the conditions under which institutional change occurs employs a constructivist perspective by the construction of narratives. As the authors observe, crises may create the conditions for grand policy change because, at that time, it is more arguable that the existing paradigm is not adequate, and the credibility of this paradigm is challenged giving the opportunity for an alternative paradigm to be placed. They state that the role of narratives is a key one because crises are events that need to be interpreted, narrated and explained to focus the attention of relevant actors. A successful narrative may instil the perception that a crisis is occurring, offers explanations about why this event should be considered as a crisis, and what can be the solutions to solve the crisis. For paradigms, narratives are important because they may demonstrate the inadequacy of the paradigm. However, these narratives need to be credible and offer alternatives to replace the existing paradigm.

Kern, Kuzemko and Mitchell (2014) state that it is suggested by the literature that one alternative narrative dominates the process of replacing a policy paradigm. However, from their study of UK energy policy, they found the existence of more than one crisis narrative influencing the process of policy change. This finding can explain in more detail the process of policy change as a less linear process and the structure of the new paradigm emerging from a crisis. After a dramatic event, the new paradigm can be something complex with internal tensions due to the existence of new ideas, which are combined with old ones that persist in the system.

Birkland (2006) draws attention to how different interpretations of crises arise and how these initiate policy change and policy learning following catastrophic events. They examine a variety of disasters, crises and catastrophes (both natural and man-made), drawing upon the work of Kingdon and a variety of other authors, such as May and Sabatier, to highlight the role of catastrophic events in focusing the policymaking process. In this study, Birkland (2006) is interested in the analysis of how catastrophic events change the perception of problems and policy, and whether these events led to policy change as a result of policy learning, or whether policy change took place without learning. Similarly, Farley *et al*. (2007) examine the case of hurricane Katrina (again employing the idea that a dramatic event, in this case a disaster, serves to focus attention) with the aim of explaining policy responses and the opportunity for ecological economics to influence those responses.

In the same line, Boin, t Hart and McConnell (2009) explain that crises have the feature to be perceived by a large number of members of diverse communities. These members may perceive the crises as threats for their values or the structure of their communities. The authors highlight that it is important to note that crises and their effects are not perceived uniformly by the communities or by the members within the same community. These different perceptions that actors have reflect the distinct values and positions of actors, which is crucial to exploit the crisis as was previously mentioned. From these studies, and others like them (e.g. Kingdon, 2003 and Keeler, 1993), it is possible to derive the idea of crises as 'policy windows' to reform policy and identify the role of pre-existing ideas for how to deal with these untoward events. In general, these studies frame catastrophic events as focusing events, which are episodic situations where policy responds with urgent and short term measures.

From the perspective of the role of ideas in policy change related to crises, Menahem (2008) elevates the role of the ideas as the driver of policy change and shifts in policy paradigms. He argues that they are an independent driver and endogenous factor for policy change. Findings show that, in the literature of policy change, it is recognised that exogenous factors (like crises) play a key role in dramatic changes. However, even though external factors may pressure for changes in policies, actually, the changes in policies are often shaped by ideas. Ideas matter, and they do not just influence the policy choices responding to exogenous factors. In the absence of those factors, ideas also pressure for changes.

Menahem (2008) points out that there are two types of ideas: cognitive ideas and normative ideas. Following Schmidt (2002, 2008) cognitive ideas indicate ''what is and what to do' providing recipes for action' [whilst] normative ideas are those 'that attach value to political action and serve to legitimate policies and programs through reference to their appropriateness'' (Menahem, 2008 p.503). According Menahem (2008), this distinction is important in explaining why some ideas that are promoted by policy entrepreneurs became dominant over others.

Nohrstedt and Weible (2010) also refer to the role of ideas in policy change related to external events. They link external events to policy change and policy subsystems, employing Sabatier's advocacy coalition framework as theoretical lens. The authors note that, in the literature, it has been assumed that crises have a substantial impact on public policies, and that policies are difficult to change because they are rooted and embedded in settings that are already developed and institutionalised; there is an equilibrium that cannot be changed from inside. Stimuli for major changes come from factors external to the policy subsystem. According to them, this assumption is partially explained due to the literature not being accurate when it talks about external shocks, which may cover a large variety of events. External shocks are called 'external events', 'external perturbations', 'external shocks', 'focusing events' or 'critical junctures'. Findings show that, after crises, different coalitions compete for framing the causes and effects of crises, but changes rarely promote new policy problems and new solutions. In fact, crises open windows of opportunity for actors to promote their pet problems and solutions that already exist in the system. Naming external shocks differently suggests the existence of different conceptualisations of crises; this may lead to a lack of understanding of the particular characteristics of these events and how those characteristics are related to policy responses.

In their analysis of the UK flooding crises and their impact on policy change, Penning-Rowsell, Johnson and Tunstall (2006) argue that crises generate 'windows of opportunity' for catalytic policy change. At those times, the rate of changes in policy can be accelerated due to the increase in the range of actors and the new ideas they bring to the system. Their findings show that no new ideas were introduced to the system despite the presence of new actors: the changes in policy were already around. The authors conclude that, at the current time, it is possible to identify those ideas that will be implemented as policy responses when a crisis comes. Those ideas can be seen as signals of the policies that will be accelerated in the future in a context of crisis. The framing of the role of ideas as drivers of policy change, and the perspective that actors try to convince each other about the causes of crises, may help to understand better how policy makers define problems and why policy responses are designed in a particular way.

From the perspective of how crises provoke a paradigm shift, Walgrave and Varone (2008) studied how much attention from a crisis is needed to provoke major changes in policies. They tested Baumgartner and Jones's theory of punctuated equilibrium in a political context (Dutroux case in Belgium) different from the original study (United States), arguing that the sole increase in issue attention, policy images[3] and new policy venues[4], do not lead automatically to major changes in policy. They conclude that the role of political parties was determinant in the Belgian context to explain major policy change. A critical issue for policy change is the political issue attention where the political actors should invest resources such as money and time prior the policy change. On the other hand, according to Boin, t Hart and McConnell (2009), actors feel and decide whether a crisis gives an opportunity for major policy change or just incremental ones. In the case of a dramatic change, this will depend on how powerful the narratives around are to destabilise and delegitimise the existing policies.

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[3] '[They] are policy communities' shared ideas about the policy at stake. They explain what the issue is about, how it should be seen, and which solutions are appropriate' (Walgrave and Varone, 2008 p.367).

[4] '[They] are institutional arenas where decisions on an issue can be taken' (Walgrave and Varone, 2008 p.367).

Wilson (2000) discusses paradigm shift from a policy regime perspective. He employs the international regime literature and Kratochwil and Ruggie's definition of regime as

> '...governing arrangements constructed by states to coordinate their expectations and organize aspects of international behaviour in various issue-areas. They thus comprise a normative element, state practice, and organizational roles. Examples include the trade regime, the monetary regime, the oceans regime, and others' (Kratochwil and Ruggie, 1997 p.32 quoted in Wilson, 2000).

According to Wilson (2000), policy regimes have four dimensions: a power dimension or its arrangement, the policy paradigm dimension, the organisation dimension within the government, and the dimension of policy itself. He argues that in order to have a policy regime change, the presence of stressors or enablers is needed, which create conditions for change. His apparent view is that a change in a policy regime occurs in phases, however, this cannot be seen as a linear process and some phases may occur simultaneously.

The first phase involves the presence of a stressor that challenges and weakens the policy regime. This stressor discredits the dominant paradigm, giving actors the opportunity to raise new problems and an alternative paradigm. There are many types of stressors. One of them corresponds to crises that alter the routine or *status quo* and promote the shift in power. A policy regime change does not occur automatically, or just because of the existence of stressors such as crises. However, as said before, they create the conditions for change, and their function is to stimulate a shift in the policy paradigm that supports a change in the regime. Paradigm shifts occur when stressors become inconsistent with the dominant paradigm; they (the stressors) can be explained better or in a more convincing way for an alternative paradigm that may exist at the same time of the dominant paradigm. The second phase in a policy regime change corresponds to the 'legitimation of crisis'. This basically occurs because of the loss of confidence actors have in the dominant paradigm. The following phase consists in the shift of power. There is a considerable variety of possible shifts in power and some of them may occur at the same time. Finally, the last phase occurs when there are changes in the organisation of the implementation of policies and in the goals of those policies.

It seems that Walgrave and Varone (2008), Boin, t Hart and McConnell (2009), and Wilson (2000) frame radical policy change as a political process. This view may limit the analysis of the timing or steps by which radical policy change is likely to occur. More technical issues regarding crises may be linked to the different phases of these events.

The above discussion has identified some important work around policy learning and policy change associated with catastrophic events. In the following section we identify four areas in which there are gaps, and discuss possible ways to take our understanding further. In the identification of these four gaps, Birkland (2006) is an exception to the rest of the policy learning and policy change literature, because he limits his study and focuses on policy responses after dramatic events. For this reason, the work of Birkland can be related to each of the identified gaps.

The first gap in the literature is that, theoretically, the concept of crisis has not been discussed in detail. As mentioned before, Nohrstedt and Weible (2010) note that the literature has vaguely discussed the concept of external shocks, which may cover a large variety of events. It implies that the particular features of crises (see Table 2.2 on page 30) have not been related to policy responses in a policy learning process. We argue that policy responses to crises are directly related to their characteristics, which guide the policy responses at a certain point in time. Birkland (2006) discusses the concepts of crises, disasters and catastrophes, and considers the particular features of several disasters and how these features had an effect on the development of policy. For example, regarding the 11 September 2001 attacks in the United States, he notes that a distinguishing feature of that disaster was that substantial policy efforts were undertaken prior to the attack to attempt to prevent a terrorist attack on the homeland, but that these failed to anticipate the specific features of the disaster that actually occurred. Nonetheless, he does consider issues of social and instrumental policy learning and how existing ideas prior to the attacks led to the development of new policy instruments.

The second gap is that the causes or origins of crises have not been explored to inform a more general analysis on the definition of problems to be faced by policymakers, and how those causes guide the design of policy responses to address the crises. According to Boin, t Hart and McConnell (2009), in the aftermath of crises, actors exploit the opportunity to change policies. A framing contest occurs and actors try to persuade and convince each other about what they think the origins of the crisis were and what actions should be taken. Considering the claim made by Penning-Rowsell, Johnson and Tunstall (2006) about crises as ‘windows of opportunity’ for catalytic policy change, and taking into account their argument that, when this window is open, the rate of changes in policy can be accelerated, we extend this view of crises as policy change accelerators and argue that, in the same way, they can be considered as policy learning precipitators. We argue that crises are powerful events that create opportunities for accelerating the reform of regulatory frameworks and trigger policy learning processes. This research adopts Keeler's definition of policy reform as 'policy innovation manifesting an unusually substantial redirection or reinforcement of previous public policy' (Keeler, 1993, p.434). This definition is consistent with the positive connotation of crises as events to make innovations, turning points and stimuli for radical changes. As said before, crises as policy windows constitute opportunities for major changes (Kingdon, 2003) and an opportunity for a shift in the policy paradigm (Hall, 1993), as will be seen later.

Birkland (2006) mentions the underlying causal theory of public problems. He relates this to social policy learning as conceptualised by May (1992), pointing out that if social policy learning takes place, there will be a better understanding of the causalities in problems. Taking again the example of 11 September 2001, Birkland states that this terrorist attack led to policymakers, and people in general, thinking about terrorist attacks in a different way; ways that were not thought of in the past were from that moment considered. Despite this, Birkland focuses on how policy responded to the attacks from a better understanding of terrorism, defined as a policy problem without too much relationship between that policy problem and its causes.

The third gap is the limited view that the literature has on catastrophic events. It considers them as focusing events that take the attention of policymakers (Kingdon, 2003): they are events that last for a relatively short period. We identify these as 'transient or episodic disturbances'. The policy learning and policy change literature lacks any further analysis on how crises evolve over time and the relationship between that evolution and policymaking processes. This implies that the distinct phases of crises have not been connected with the processes of policy learning and policy change and the forms that these processes may take, which leads to a limited understanding about how and why policy responds to crises according to their different stages.

We argue that crises are dynamic, enduring and persistent events, and that the evolutionary phases of crises create a dynamic process of policy learning and policy change. We also argue that developing this relationship would allow a more comprehensive and systematic analysis to study learning and changes in policy stimulated by catastrophic events. For instance, this would improve understanding about how more radical, or potentially radical, as well as incremental changes might be made in policies, and when it is more likely to expect an incremental policy change or a paradigm shift in policy, as will be discussed later. Birkland (2006) draws his study on the work of Kingdon and the role of catastrophic events as focusing events. In all cases he explains how the disasters rapidly seized the attention of relevant actors to develop policy. Nevertheless, the cases focus on the salient feature of disasters, but not on how those disasters evolved over time and how policy responded to that evolution.

The fourth gap in the literature is the absence of a deep analysis about the role of catastrophic events in creating opportunities for radical policy change. The existing literature on policy learning and policy change refers to radical policy change and the potential of catastrophic events as accelerators of radical policy change. However, it does not analyse in detail the timings or steps by which radical policy changes are likely to occur after a dramatic event. We argue that crises are powerful events that create opportunities for radical policy change, and that they alter the timing of decision-making for introducing those substantial changes. The changes in policy are linked to the phases of crises.

Birkland (2006) discusses how policy dramatically changes after disasters. For example, in the case of aviation security, he reports how 09/11 effected many policy changes in aviation security that led to new policy instruments. However, he explains that the design of these instruments was a result of a collection of ideas and experience accumulated and developed before the 09/11 attacks to improve security in aviation, but that had not been applied. He concludes that 09/11 shows some evidence of learning in developing policy responses but a failure in implementing that learning.

Summary:

This section has explained the role of crises as precipitators of policy learning and policy change. Especially when there is no policy ready to respond to crises, these events push sudden changes in policy and provide the opportunity for major changes to occur. The section has also posed four gaps identified in the policy learning and policy change literature. The next sections take forward the particular features of crises, the causes of crises to inform policy responses, the evolutionary stages of crises in developing and implementing policy responses, and the opportunities for radical policy change after dramatic events to continue to answer the research questions.

2.4. Causes of crises as the basis for policy responses

This section takes forward the idea of causes of crises to discuss how these causes inform the design of policy responses. The variety of responses that policymakers start to consider after a crisis may have their origins in the conditions that stimulated the crisis. The section begins with a discussion of traditional explanations about why resource crises occur. The second section proposes an alternative explanation to the traditional ones. Finally, the last section discusses how explanations of resource crises may be taken into account to design policy responses.

2.4.1. Traditional explanations of causes of resource crises

In the environmental politics literature, the studies of Irving and Priddle (1971), Ophuls (1977), Sprout and Sprout (1978), and Garner (2000), indicate that resource crises are mainly linked to issues such as resource scarcity, pollution and resource depletion and degradation, including the overexploitation of resources. Garner (2000) points out that the focus of the studies within that literature is the human impact on the natural environment. Hardin's tragedy of the commons and Ostrom's collective action theory are the traditional lenses by which this phenomenon has been studied. These studies deal with individual issues. For example, Hardin's tragedy of the commons deals with the self-interest of actors exploiting a common resource, and Ostrom's collective action theory deals with a form of actors' organisation to exploit a common resource in a more sustainable way. However, since these individual issues are strongly linked with ecological systems, a systemic view is needed to complement these traditional explanations and include more aspects that may also play a role in the issues under study. For example, in the case of Hardin, more detail of the conditions that lead to actors to behave in a self-interested manner, such as the regulatory environment and social norms, could be interesting to analyse.

Hardin (2009) states that, in the 'tragedy of the commons', common resources tend to be abused through over-exploitation. This abuse is usually translated as a self-destructive logic of the common resource due to its overuse, and/or the creation of negative externalities (e.g. pollution) produced by rational self-interest and individualistic views, which, in turn, lead to a competitive overexploitation and degradation of the resource.

Since the common resource is not unlimited, both its competitive overexploitation and degradation through pollution end in a mutual resource crisis. The tragedy occurs because of the unsustainable ecological exploitation and management of the natural resource. To deal with, and avoid, this tragedy, Hardin argues that personal freedoms need to be impinged by restricting the liberty of access and use of the common resource through the institution of private property (i.e. privatisation), or its management as public property in which the allocation of usage and access rights are government decisions.

Iizuka and Katz (2010, 2011) and Katz, Iizuka and Muñoz (2011), point out that the sanitary crisis of the Chilean salmon industry is a new version of the tragedy of the commons. Focusing mainly on firm behaviour, they state that the sanitary and environmental mismanagement by producer firms was the direct cause of the crisis. According to them, the increase in world salmon prices strongly incentivised an increase in salmon production, which was achieved through an increase in fish density (fish per cubic metre of water). The results of this increase in fish density were translated in a significant increase of the profitability of the firms, and at the same time in a more intensive use of the common resource of water that eventually ended in its overuse[5]. The intensive use of the water caused the deterioration in the conditions of the production environment that led, in the end, to a higher vulnerability of fish pathogens, higher levels of fish mortality and, cumulatively, to a decrease in the productivity of the whole industry. They assume that all the firms behaved independently and in an individualistic and profit maximisation manner.

This view is shared by Vera (2010) who points out that two out of the three main causes of the crisis were the profit maximising behaviour of firms. Little attention was paid to biological-sanitary issues and the excessive desire of the firms to reduce production costs and increase profits at the expense of a delicate biological resource such as salmon. In Iizuka and Katz (2011), and in Vera's perspective, in a certain way the crisis revealed a biological-sanitary or biological-environmental mismanagement originating from inadequate farming practices by the firms.

The focus on firm behaviour, and the assumption that all firms behave in the same way, might be an oversimplification of a more complex problem of an industry that is part of an ecological system such as salmon farming. Kemp (2004) explains that one of the most important factors of ecology is the interdependence of different organisms including humans and the relationship among them and with the environment. Taking Kemp's explanation into account, an analysis of a more complete set of actors, the relationships between them and with the water as a resource, and with the regulatory environment that regulates that resource, rather than just considering isolated actions of producer firms, might offer insights that are unavailable from the approach based on an analysis of firm behaviour.

[5] This thesis considers salmon production by farming methods in which volumes of water are enclosed. Water is not the limiting factor since these enclosures are typically open to the ocean. However, this turns out to be part of the problem because the virus studied (ISAv) can be transmitted to other marine organisms that are not contained in the enclosures.

For example, Dahlman (1991) strongly criticises Hardin's tragedy of the commons, arguing that the common resources were not really common and that there was no tragedy. According to Dahlman, on the one hand, in the open systems such as those described by Hardin, at that time in history there were different rights in place over the use of those resources (e.g. common pasture and common estuary). Moreover, those rights were neither universal nor unlimited. By contrast, there were rights that belonged to, and were limited to, the owners or tenants who lived in the villages where the resources were located, and therefore outsiders did not have rights over the use of those resources.

On the other hand, Dahlman argues that there was no tragedy because the rights and rules implemented helped to prevent the overuse of the common resources. Rules to limit rights over the resources by, for example, limiting the number of animals grazing in an area, and rules to avoid resource overuse were embedded in practice. In this way, rights and rules were meant to control and protect the overuse of common resources through two mechanisms: limiting free access and restrictions on the quantity of rights. However, Dahlman notes that even with norms and rights in place, the overexploitation of the commons could still happen. This would occur due to ineffective attempts to regulate the resource because the limits were too liberal or not properly enforced. Liberal limits and proper enforcement are not just failures of local regulation but also of state regulation. This might be related to under-developed government structures with lack of capacity (i.e. resources), and capabilities (i.e. competencies) of regulators and bureaucrats to ensure a correct design and implementation of laws and regulations: these are usually a feature of developing countries. Finally, Dahlman points out that if the common resources were overused and exhausted in the way that Hardin describes, they would have had no economic value. However, historic records show that those resources had an important economic value.

Hardin's tragedy of the commons, and Dahlman discussion on Hardin's tragedy, suggests that whether a resource crisis occurs is partly due to a failure to develop suitable rules and regulations to control the resource, to develop a system to allocate private ownership or property rights, or a lack of enforcement of coercive laws to protect the resource. When rules and regulations are developed by the government, regulatory capture might occur. Levine and Forrence (1990) and Laffont and Tirole (1991) discuss the regulatory capture theory in which the government makes decisions on behalf of the narrow interests of group users. In the case of a natural resource crisis, regulatory capture may occur when the government is 'captured' by favouring the interests of some users through a convenient design and implementation of regulation rather than protecting the resource from overexploitation or degradation.

The two solutions proposed by Hardin to solve problems of overuse (government ownership and privatisation) imply a system to determine who uses what, for how long and under what conditions. The government ownership solution assumes a capacity for government ownership that may not be feasible in a development context due to limits on the resources available for enforcement (as said above), or the possibility of political destabilisation in extending enforcement.

In the tragedy of the commons, Hardin's prediction of the inevitable destruction of common resources is based on the assumption that all the individuals concerned are rational, behave in the same selfish manner, and want to maximise their results in the short-term. However, Ostrom *et al*. (1999) point out that even when this is possible, in most situations there are likely to be a variety of users that have different norms of behaviour; for example, some users might be more altruistic in taking care of the resource in order to maintain a positive result for the group. In that particular case, the self-interested behaviour may be dominant only where the proportion of those who are self-interested is higher than the proportion of the other users, such as an altruistic group. Thus, the destruction of common resources as portrayed by Hardin may not always be the case, and therefore there may be other alternatives in which rational individuals voluntarily look for cooperation towards a sustainable management of common resources.

Challenging Hardin's assumptions, Ostrom (1990) developed a theory based on collective action. In her theory, individuals will cooperate and develop norms and rules by themselves to solve Common-Pool Resource (CPR) dilemmas such as resource overuse. Resource overuse has been pointed out as one of the main causes of natural resource crises (e.g. Hardin, 2009; Ophuls, 1977), such as the sanitary crisis of the Chilean salmon industry. According to Ostrom *et al*. (1999) CRPs are 'natural and human constructed resource systems in which the exclusion of beneficiaries through physical and institutional means is especially costly (excludable) and the exploitation by one user reduces resource availability for others (subtractable)' (p.278).

This is the case of aquaculture, farmed fish and salmon farming in which it is costly but not impossible to exclude other beneficiaries such as artisanal fishery and the tourism sector from the use of fresh or salt water. Since those resource systems such as fresh or salt water are subtractable they face overuse problems. Ostrom's theory is an alternative different from the government ownership or privatisation alternatives proposed by Hardin. In this theory of collective action solutions for CPR problems involve the restriction of access to the resource, and the creation of incentives to resource users who would prefer to invest in the common-pool resource rather than to exploit it. Ostrom *et al*. (1999) state that, commonly, this restriction of access and the creation of incentives is made by allocating rights to the users or shares in the common resource. In the new version of the tragedy of the commons for the Chilean salmon industry, described by Iizuka and Katz (2011), they point out that 'lack of collective action and institutional arrangement to monitor and manage the CPR [water] eventually damaged the long term sustainability of the industry' (p.281).

To sum up, the commons approach tells us that natural resource crises are due to a blind self-interest of individuals, or institutional failures to look after common resources and avoid their overuse. This approach may be extended to the interest of states in developing sectors and industries based on natural resources in an unsuitable manner by putting economic priorities before ecological ones. On the other hand, the collective action theory tells us that the tragedy of commons can be avoided if actors do not act in a self-interested manner. At the same time, it suggests that a failure of resource users in voluntarily organising themselves towards a sustainable exploitation and management of common resources creates the conditions for natural resource crises. However, in complex ecological systems such as salmon farming, the overexploitation and degradation of natural resources, as well as failures of institutions and collective action, seem to be partial explanations about why and how resource crises occur. There could be other distinct causes from just the misuse of resources due to the blind self-interest of users and the state, institutional failures and lack of collective organisation by resource' users. This motivates the next section in which an alternative explanation to the traditional explanations of causes of resource crises is provided.

2.4.2. Alternative explanation of causes of resource crises

Sprout and Sprout (1978) and Garner (2000) indicate that multiple and interdependent factors (that we may call failures) are involved in the origins of resource crises. This suggests that it would be a mistake to consider that the origins of an industry natural resource crisis are likely to be caused by just one failure, or that those failures are unrelated to each other. This multiple interdependence of failures suggests that a system perspective to look at these problems is missing. There is a need to consider a more holistic and systemic perspective to analyse the failures over natural resources, and the causes of natural resource crises stimulated by those failures, and in this way to offer a more complete explanation about them.

In fact, in this research, primary data gathered in extensive fieldwork revealed that the sanitary crisis of the Chilean salmon industry cannot be assigned to just one direct cause, for example, water overuse or an institutional failure. On the contrary, all the industry actors interviewed reported a variety of interdependent conditions (which actors deliberately portrayed as failures of the industry and the sector in which the industry is embedded), corresponding to different categories, and identified interactions between them and different actors and institutions that together contributed to the emergency of the crisis.

The existence of a variety of interdependent failures, a variety of failure categories, and the interaction between actors and institutions suggests that the sanitary crisis in the Chilean industry was not just a consequence of a resource overuse or failure of collective action, as is suggested by the explanations provided by Iizuka and Katz (2010, 2011) and Katz, Iizuka and Muñoz (2011), but rather it was a consequence of a more complex process. These consequences included the poor and strong interaction among different actors (e.g. producers, universities, bureaucrats), the lack of organisational and technical capabilities in producers and bureaucrats, the lack of an adequate infrastructure to control the industry, the failure of the industry regulatory framework, a lack of trust among producers and issues related to nature (e.g. weather conditions) to name a few. This will be discussed further in Chapter 5.

Like innovation, which rarely occurs in isolation and whose unique points of failure are difficult to identify when they appear (Metcalfe and Georghiou, 1997; Smith, 2000), the causes of an industry natural resource crisis can rarely be attributable to a unique direct cause given the multiple interdependence of failures that can be found in ecological systems. Natural resource crises do not occur by just a single cause but by systemic failures.

The system approach to innovation and, in particular, the system failure analysis has become a way by which it is possible to study and understand weaknesses, fragilities and vulnerabilities of systems. This literature has been mainly applied to manufacturing sectors (e.g. Malerba, 2002; Smith, 2000), and more recently extended to service sectors (e.g. Rubalcaba, Gallego and Hertog, 2010). This suggests that it may also be applied to ecological systems, and be a suitable approach for analysing the causes of natural resource crises, since it allows the interdependent analysis that is needed in studying ecological systems. Moreover, natural resource systems as sources of production may also be considered as sources of innovation.

In the system of innovation literature Metcalfe (2005) and Woolthuis, Lankhuizen and Gilsing (2005) point out that a system failure can be understood as systemic imperfections that can occur in an innovation system that affect its efficiency. Applying this understanding to a natural resource system, we may say that natural resource crises occur through a system failure because there are systemic imperfections that alter the efficiency of those natural systems and make them unsustainable, for example reducing their quality and quantity.

As noted by Redclift (1992), sustainability and sustainable development are concepts with a wide interpretation. This ambiguity comes partially from the object of concern; for many the concern of sustainability has a natural resource base and for others it is related to levels of production and consumption. As a consequence, there are conflicting opinions on the manner in which sustainability and sustainable development might be achieved. As will be seen later in Chapter 5, this research shows a tension between these interpretations of sustainability and sustainable development.

Authors such as Johnson and Gregersen (1995), Breschi and Malerba (1997), Smith (1997; 2000), Carlsson and Jacobsson (1997) and Edquist *et al*. (1998) have paid attention to the different types of failures in innovation that Woolthuis, Lankhuizen and Gilsing (2005) summarises as follows:

- Infrastructural failure: related to physical infrastructure that is needed to conduct innovation;
- Institutional failure: classified into hard institutional failures (i.e. formal institutional instruments that could be barriers to innovations, for example, regulations, policies and standards), and soft institutional failures (i.e. social and political context that can obstruct innovations such as social norms and values);
- Interaction failure: related to links and networks that stimulate or hamper innovation, classified into strong and weak networks;
- Capabilities' failure: related to competencies of the actors to conduct innovation.

Applying the above taxonomy to natural resource systems, the failures that can lead the system (in this case an industry) to a natural resource crisis are:

- Infrastructural failure: related to the physical system needed for the sustainable exploitation of natural resources, their operation and development;
- Institutional failure: refers to 'the rules of the game' in which natural resources are exploited, managed, controlled and used. The rules that regulate the behaviour of the

resource users. Hard institutions refer to the formal rules (e.g. regulation, policies, laws and standards) over natural resources. Soft institutions or social norms refer to the social and political context that can obstruct the sustainable development of natural resources involving the values and beliefs that shape policy;

- Interaction failure: related to the interaction among resource users and other actors related to the resource (e.g. regulatory bodies and NGOs). A weak interaction follows poor coordination and connectivity among actors that prevents synergies towards the sustainable development of the resource. A strong interaction follows a dominant dependence among actors that may also prevent the sustainable development of the resource;
- Capabilities' failure: a lack of competencies and capacities of the resource users and managers (e.g. private sector and public agencies) to sustain the natural resource and its development.

The four categories mentioned above address the variety of failures associated with natural resources. However, natural resource systems deal with a considerable degree of uncertainty (e.g. unexpected factors such as natural conditions and natural disasters), which the innovation system failure taxonomy, and its adaptation to natural resource systems, posed above does not take into account. It is crucial to include this uncertainty in the analysis of both natural resource and innovation systems. In both systems the uncertainty may lead to 'unexpected failures'. Adding this category of failures to the system failure taxonomy and its adaptation to natural resource systems corrects the deficiency of the approach.

The following table summarises the failures in both system of innovation and natural resources systems.

Table 2.3: Failures in innovation and natural resource systems

Failures		System of innovation	Natural resource systems
Institutional	Hard	Formal institutional instruments that act as barriers to innovation (e.g. laws and risk management rules)	Formal rules of the game that regulate, control and manage resources (e.g. The Chilean General Law of Fishing and Aquaculture)
	Soft	Social and political context that can obstruct innovation (e.g. social norms and values)	Social and political context that can obstruct the sustainable development of resources (e.g. blind self-interested behaviour of salmon producers)
Infrastructural		Physical infrastructure needed to conduct innovation (e.g. science and technology infrastructure)	Physical system needed for sustainable development of resources (e.g. lack of infrastructural resources such as boats of the sanitary authority to control salmon farms)
Interaction	Weak	Lack of interaction that obstructs innovation (e.g. poor interaction among organisations in a system)	Poor coordination and connectivity among actors related to resources (e.g. poor connection between scientific knowledge providers and salmon producers)
	Strong	Strong interaction that prevents innovation (e.g. myopia due to internal orientation)	Dominant dependence of actors related to resources that prevent their sustainable development (e.g. complicity between clients and providers of environmental reports)
Capabilities		Competence of actors to conduct innovation (e.g. learning potential and resources)	Lack of competencies and capacities of actors related to resources (e.g. lack of knowledge to grow out salmon in a sustainable manner)
Unexpected		Unexpected factors that hamper innovation	Unexpected factors affecting the sustainable development of resources (e.g. natural conditions such as a hotter season than usual)

Source: Own elaboration based on Woolthuis, Lankhuizen and Gilsing (2005).

To sum up, since the commons and collective action approaches offer partial explanations about natural resource crises, this research has proposed an adaptation of the system failure approach to ecological systems. This adaptation includes the addition of a category to consider unexpected failures that are crucial to ecological systems such as natural resource systems. This ecological system failure approach offers a more complete analysis to explain natural resource crises since it adopts a more holistic perspective involving different interrelated factors that may play a role in industrial natural resource crises. Moreover, it considers a more complete set of actors and institutions, and their relationships, that may play a role in causing an industry natural resource crisis. Although the ecological system failure approach offers a good basis for explaining causes of natural resource crises, it says little for how those causes are interpreted and how problems to be faced by policymakers are defined. The next section takes forward the system failure analysis and discusses how the causes of natural resource crises can be transformed into policy problems.

2.4.3. Basis for policy responses to resource crises

The interdependence of failures revealing problems in natural resource crises suggests that, in an industry natural resource crisis caused by an ecological system failure, the understanding and solutions over crises are complex matters. Policymakers may understand and interpret failures and their connections differently and therefore make different causal links to translate those failures into problems to be faced (i.e. policy problems). Stone (1989) analyses how causality is made in defining policy problems. In her study she proposes a typology in which she categorises the actions into unguided and purposeful, and the consequences of those actions into intended and unintended. The combination of actions and consequences results in four types of narrative about how individuals define problems. The following table shows an adaptation of Stone's (1989) framework about causality in defining policy problems. Each box contains a different narrative about the explanations of policy problems.

Table 2.4: Narratives

		Consequences	
		Intended	**Unintended**
Actions	**Unguided**	Mechanical cause: Policy problems are explained by indirectly guided actions through an intervening agent that have caused intended consequences	Accidental cause: Policy problems are explained by accidents or events that just occur, for example, natural disasters
	Purposeful	Intentional cause: Policy problems are explained by purposeful actions of humankind that achieve the required consequences	Inadvertent cause: Policy problems are explained by wilful actions which have caused unexpected (negative) consequences

Source: Own elaboration based on Stone (1989).

The construction of these narratives may be explained by the dynamic of three dimensions: cognition, awareness, and beliefs and values. Each dimension contains elements that have been classified and grouped into the three dimensions in order to organise the processes used by actors to build their systems of references about means and ends into different but interdependent schemes. The following figure presents these elements grouped into the three dimensions.

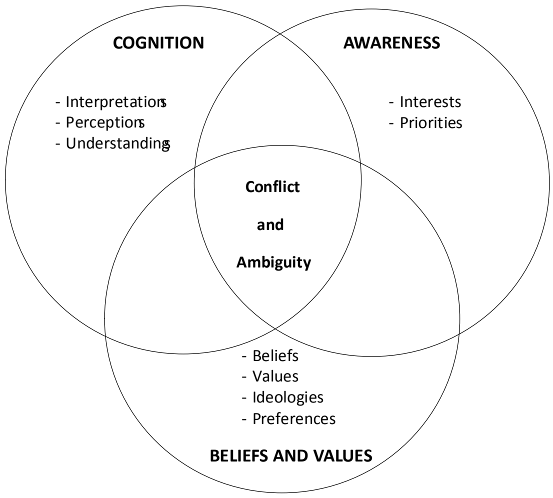

Figure 2.1: Construction of narratives in policymaking process
Source: Own elaboration based on Sanz (1995), Slembeck (1997, 2003), Kingdon (2003) and Howlett, Ramesh and Perl (2009).

Cognition refers to the processes by which knowledge and understanding are developed by the actors according to their experiences and relationships with others. As discussed by Kingdon (2003) and Slembeck (1997), this involves interpretations, understandings and perceptions that actors have regarding a particular phenomenon or situation. Awareness refers to interests and priorities defined by actors. Sanz (1995) points out that while ideas may define choices, interests and priorities shape and constrain them. As discussed by Slembeck (1997, 2003) and Howlett, Ramesh and Perl (2009), beliefs and values include beliefs, values, ideologies and preferences that actors have. According to Slembeck (1997, 2003) beliefs construct mental models about how the world is perceived, interpreted and understood; they also allow communication with others. In this approach, problems emerge due to discrepancies between how people perceive the world and how the world actually is, or how the world is and how people believe it ought to be.

The interaction of the three dimensions of interpretations, interests and preferences implies that there is interdependence among cognition, awareness, and beliefs and values. Each dimension affects the others. Cognition is shaped by awareness and beliefs and values. Beliefs and values may change as they are influenced by cognition and awareness. Interpretations about the world are framed into how the world is perceived and how it is believed the world ought to be. Beliefs and values orient interests and priorities that are referenced to how the world has been constructed.

In addition to explaining the construction of narratives in policymaking, cognition, awareness, and beliefs and values contain the elements that interplay in the manner of how conflict and ambiguity arise in defining policy problems and, more generally, in the policymaking process. The outcomes of the interaction of these three dimensions are explanations about why conflict and ambiguity arise in defining policy problems, and the way in which choices to solve those problems are shaped and constrained. Conflict and ambiguity in defining policy problems and in the policymaking process emerge when there are discrepancies or divergences among cognition (i.e. interpretations, perceptions and understandings), awareness (interests and priorities), or beliefs and values (including ideologies and preferences). Slembeck (2003) indicates that those discrepancies and divergences come from the variety of interests, ideologies and interpretations existing in the system.

Surel (2000) defines cognitive frames as distinct forms of thoughts or forms of understandings. We may say that narratives are linked to cognitive frames, which are based upon premises that underlay narratives and arguments. These premises are built within paradigms. Defined by Hall (1993), paradigms represent ‘world views’ establishing how the world operates based on certain understandings, interests and beliefs. As stated by Surel (2000), one of the functions of the cognitive frames and paradigms is the construction of specific identities among actors. Since actors are connected by particular understandings, interests and beliefs that allow them to make sense of the world, they develop communities whose dynamics, principles and possibilities of action are bounded by the way they see and understand the world, the paradigm. This function of paradigms in this approach is a good complement to Sabatier’s definition of advocacy coalitions: ‘people from a variety of positions (elected and agency officials, interest group leaders, researchers) who share a particular belief system, i.e. a set of basic values, causal assumptions, and problems perceptions, and who show a non-trivial degree of coordinated activity over time’ (Sabatier, 1988, p.139). In this way cognitive frames and paradigms lead to the formation of coalitions. According to Sabatier (1988), coalitions will try to translate their beliefs into policies influencing the processes of policy formation and policy implementation.

Combining the elements discussed above (i.e. failures, narratives, cognitive frames and paradigms) about how individuals define policy problems, the following figure shows the hierarchy of those elements in making social constructions towards the definition of policy problems in which paradigms are built according to cognitive frames, which are built as a response to failures that are explained through narratives. In the figure failures appear external to the triangle because this means that they are rationalised within the frame of a certain paradigm through the construction of narratives, which become cognitive frames. This leaves a question about the existence of multiple paradigms for multiple actors, or whether there is a single paradigm that is universal and what differs are the narratives and hence cognitive frames of different actors. This also leaves a question about how a diversity of failures may create divergent narratives that explain the causes of natural resource crises.

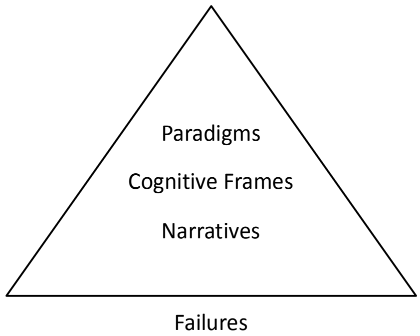

Figure 2.2: Paradigm
Source: Own elaboration based on Stone (1989), Hall (1993), Surel (2000) and Woolthuis, Lankhuizen and Gilsing (2005).

In the explanations about causes of crises, crises interact with pre-existing perceptions of failures that are seized and exploited in the construction of narratives. This suggests that crises act as amplifiers of past issues, bringing to the present issues that have been latent for some time. This was the case with the sanitary crisis in Chilean salmon farming where the crisis renewed the conflict between ecological and neoliberal positions on industry issues such as the approach of the industry policy, as will be seen in Chapter 5.

To sum up, as the previous sub-section explained, the origins of an industry natural resource crisis cannot be attributed to just one cause due to the multiple interdependence of failures that characterised ecological systems. A systemic approach is needed to analyse the origins of the crises of ecological systems, such as salmon farming, to take into account the interdependence of failures that may play a role in the onset of these events. This sub-section has explained that explanations about causes of the crises depend on the narratives that relevant actors construct according to their own cognitive frames, which follow the ways in which they understand how the world operates (paradigms). These narratives are based on how the actors understand and interpret failures and make causal links to translate those failures into policy problems. The existence of a variety of narratives explaining the causes of natural resource crises may guide the design of policy responses that may diverge according to those narratives. The next section discusses how policy responses to crises are designed and implemented.

2.5. Policy responses to crises

The previous sections have indicated that crises can lead to changes in policy, proposing that those changes will emerge as a learning process. Also, the effects of crises through a system failure approach have been reviewed, indicating that a variety of narratives to explain crises may lead to divergent policy responses. However, what is likely to emerge or to be precipitated from the changes induced by crises has not been discussed. This section attempts to construct a theory of how the focusing events and policy windows from crises lead to change, and in this way answers the second research question related to how policy responses stimulated by crises are developed and implemented. In short, previous sections have indicated that, after crises, changes in policy will occur, without saying what changes will be chosen or what form they will take. This section discusses a theory of what policy response or form of policy change to crises is likely to be.

In the policy learning and policy change literature, Hall (1993) analyses the different forms that policy learning may take according to distinct but related changes in policies. In his study on economic policymaking in Britain, Hall examined the goals of economic policy, the policy instruments employed to achieve those goals, and the characteristics of those instruments. He found that the policymaking process involves three variables: the central goals that guide policy, the policy instruments to achieve those goals, and the settings of those instruments. According to this it is possible to distinguish a learning process related to simple changes in the settings of policy instruments from learning related to more significant changes in the policy instruments or policy goals.

We can take advantage of this analysis to develop some hypotheses about how the learning process in policies after crises might proceed. However, to do that, and as was pointed out in Section 2.3, in order to develop a systematic analysis about the forms that policy learning may take linked to institutional changes, at the same time we need to consider crises as enduring and persistent events that evolve over time, and look along their evolutionary phases and the features of these phases.

Literature on policy learning and policy change does not provide a view of crises as enduring and persistent events, but literature on crises and disasters management provides some insights about this, pointing out that catastrophic events evolve over time from a critical period of urgency to a period in which normality is restored (Faulkner, 2001). Based on Fink (1986) and Roberts (1994), Faulkner (2001, p.140) proposed a framework on responses to a disaster at a community level in the context of the tourism industry. In this framework catastrophic events are seen as dynamic events with clear stages that evolve over time. In these stages the features of catastrophic events are described according to the particular needs of the affected community, and some insights are provided to satisfy those needs. Interpreting those insights about how to satisfy the needs of the affected community at each stage, it is possible to think about responses to catastrophic events as being more radical or incremental. In Faulkner's framework the causes of the crises are not considered in the analysis of how they may guide the responses.

We can take advantage of Faulkner's framework and apply it to a context of industry natural resource crisis. The result of this adaptation is a framework composed of seven stages grouped into three phases. The purpose of the classification of grouping the stages of the responses into three phases is to organise the processes used by actors to respond to crises into different but consecutive and progressive schemes, and link them to processes of learning and institutional change.

Phase One. Prevention:

Stage 1. Pre-event: when actions can be taken and policies can be designed to prevent industry natural resource crises or protect industries from natural resource crises. For example, contingency plans, or plans aimed at mitigating the effects of potential crises, may be developed at this stage.

Stage 2. Precursor: when it becomes apparent that an industry natural resource crisis is inevitable. As different actors may interpret signals from the environment differently, what is apparent for some individuals is not for others.

Phase Two. Reaction:

Stage 3. Stabilisation: The point of no return when the crisis has hit and damage limitation is the main objective. When the immediate effects of the crisis have been felt and rapid actions have to be taken.

Stage 4. Normalisation: When short-term needs of the affected community must be dealt with. The objective at this point is to restore the system to normality as quickly as possible (see page 59 to clarify what 'restore the system to normality' means).

Phase Three. Recovery:

Stage 5. Improvement: Continuation of the normalisation stage, but items that could not be addressed quickly are attended to at this point.

Stage 6. Adjustment: New policies and implemented actions to deal with the crisis are tested and corrected in the light of experience and new information.

Stage 7. Resolution: Routine restored, or new improved state of the system (see page 59 to clarify what 'routine restored' means).

These three phases show the evolution of crises through different stages demonstrating (as opposed what the literature on policy learning and policy change points out), that crises have a greater effect than to momentarily focus attention. Crises produce stimuli that require learning rather than simply a response within existing cognitive frames and paradigms. This suggests that policies may react differently according to the distinct stages in the evolution of crises, and thus respond through different forms of policy learning and policy change according to the particularities of each stage. It implies that policy responses to crises are also developed and delivered in different stages.

Although Faulkner's framework does not include the adjustment stage, it is important to include it in a framework of policy learning and policy change after industry natural resource crises because, usually, when there are changes at the policy level and new policies are developed and delivered before the restoration of the routine, there is a period of adjustment in which policies may be tested in practice and dummy run periods are considered. This period allows errors to be corrected and gives time for actors to familiarise themselves with the changes. Usually during this period problems in turning new policies into practice may be expected. The adjustment stage has been added to the industry natural resource crisis framework that this research proposes.

For a dynamic approach of policy learning and policy change, Faulkner’s framework may be too linear. In dynamic processes stages can usually go backwards and have long feedback loops. For example, the implementation of policies may be accompanied by a series of adjustments. However, Faulkner’s framework provides a good starting point from where dynamic processes of policy learning and policy change can be illustrated and explained.

Hypothesising from the above discussion how the learning process in policies after catastrophic events might proceed, we may say that once the crisis has occurred, the attention of individuals in and around the government has been raised and policy makers have decided to do something about it, it becomes a policy problem. Since the policy window is open due to the definition of the crisis as a policy problem, a group of actors is mobilised to find and propose alternatives to solve the crisis itself and the problem(s) caused by the crisis. If those policies were preventively developed at the pre-event stage (first phase of the crisis) they are put in place at the stabilisation stage (second phase of the crisis) to address the crisis. This type of learning might be called ‘proactive policy learning’. However, if no previous preparation was made to prevent the crisis, proposals are developed at the stabilisation stage and corresponds to a process that we might call ‘reactive policy learning’.

As seen in Section 2.4.3, a main theme in the literature is that policy problems are framed according to the understandings, interests, and belief and values of the relevant actors. For example, Sabatier (1988) defines these relevant actors as the policy subsystem, the set of involved actors who deal with a specific policy problem. Sanz (1995) points out that the framing of policy problems in a particular way will shape the choices of alternatives to be looked at to solve them.

According to Meltsner (1972), the definition of policy problems, beliefs and values play a significant role in developing alternatives because they define orientations and frame options into desirable outcomes. Actors accept and support ideas and proposals insofar as they agree with the beliefs, interests and understandings they have, Kingdon (2003) states. Braun and Benninghoff (2003) and Kingdon (2003) say that beliefs, interests and understandings can be in conflict, and that the recognition of this conflict makes this process neither linear nor entirely rational, but bounded or constrained by the self-interests of the actors.

Matland (1995) points out that policy goals and policy instruments could not be agreed-upon given the incompatibility of understandings, interests and beliefs of actors. According to Sabatier a crucial role in limiting the conflict among actors is played by the policy brokers in 'keeping the level of political conflict within acceptable limits and with reaching some "reasonable" solution to the problem' (Sabatier, 1988 p.141). Although policy learning and policy change literature is an alternative lens to conflict theories privileging the role of ideas in policy, we argue that policy processes are not free of conflict among actors given their disagreements over policy issues.

It is expected that in earlier phases of crises more radical rather than incremental changes occur. This is because it is in the first stages of a crisis that exceptional responses to attend the non-routine problems are needed to be developed and where actors are quickly mobilised. To support this process, this may include the formation of working groups involving local experts, the connection with international organisations and experts and information campaigns, as Howlett, Ramesh and Perl (2009) states for the development of policy alternatives.

By definition, immediate and short-term policy responses will be those that are developed and applied during the reaction phase of the crisis. Further, during the stabilisation stage there continues to be emergency issues and urgent problems that demand immediate attention and action**.** It is during this stage that urgent responses are developed aimed at immediate implementation. It is expected that immediate responses will produce immediate effects.

In the normalisation stage, non-urgent but short-term needs of the affected community must be addressed with the aim, as Faulkner (2001) indicates, of 'restoring the system to normality' as quickly as possible. Faulkner (2001) indicates that normality in the context of a catastrophic event can be understood as achieving a similar state to that prior to the event. However, normality is a subjective assessment and presents ambiguities related with its measure. Actors may differ about what they see or think of as being normal. For example, some may think that, after a crisis, 'normality' is what they used to be able to do and can do no longer (this is along the same lines as what Faulkner indicates as normality). In some cases, this can be infeasible if the changes brought about by the crisis required changes in actor behaviour.

To reduce the problem of subjectivity associated with the term 'normality', for the case study being studied (Chilean salmon industry), this research adopts the levels of production as the measurable criterion of output measure to assess normality. Thus, 'normality' is an indicative goal that the actors are attempting to reach. At the normalisation stage it is likely that there will be more discussion around policy ideas that need to be translated into short-term specific policy instruments. It is expected that they will produce short and medium-term effects.

Sometimes in the 'reaction' phase governments may react slowly to crises due to rigidities (a kind of government failure) in the policies being implemented at that moment. A reason for this may be that there is no previous direct experience of the crisis, which leads to difficulties in interpreting the signals and recognising that a crisis is actually occurring, and a lack of knowledge about what to do. If the crisis occurs in a particular context for the first time and there is no experience of it, relevant actors will look for alternatives (e.g. policy instruments) in those contexts where the crisis has occurred before, for example a different country that experienced the same or similar crisis ten years ago. Rose (1991) refers to this as knowledge transfer process in which local responses are inspired by those foreign experiences which are being examined. This process may take a positivist approach that, as Freeman (2006) said, 'assumes that a thing exists in time and place and is picked up and carried over-transferred-and used in another time and/or place' (Freeman, 2006, p.379). The outcome of this process may be new policies or programmes to address the crisis. However, according to May (1992) if there was no understanding of the policy instruments to be transferred and the context from where they are transferred and being implemented, this process may lead to 'superstitious learning', 'copying' and/or 'mimicking behaviour'.

Policy learning and policy change are processes of historical dependence. Policy choices are made based on ideas and interests that are organised in policy paradigms (Hall, 1993). According to Edquist (2001a, 2001b) institutions and the political environment constrain and shape the policy choices, which, as pointed out by Sanz (1995), strengthen or inhibit the policy learning and policy change. In this relationship of mutual embeddedness between actors and their institutional environment, industries and countries develop trajectories according to what they did in the past. Lundvall and Borras (2005) state that best practice and policy transfer cannot be simply transplanted from one system to another; this is because the social and historical perspective is a cumulative process and context dependent. In the words of Freeman (2006) this may refer to a constructivist approach in which policy is treated as emergent, 'policy does not exist somewhere else in finished form, ready to be looked at and learned from, but is finished or produced in the act of looking and learning' (Freeman, 2006, p.379).

Accordingly, as the phases of the crisis evolve they are worked towards the system's normality (see page 59 for a clarification of what normality means for this research). It is expected to find more incremental changes than in earlier phases of crises as there is a re-evaluation process in the light of experience and new information of what has already been developed. This is also because the environment in which decisions are taking place is more stable than in the previous phase of the crisis, where the urgency to do something was present. This is consistent with what Howlett, Ramesh and Perl (2009) observes as 'normal policymaking'.

By definition, longer-term policy responses will be those developed and applied during the recovery phase of the crisis. Further, during the improvement stage the issues that could not be quickly addressed are addressed using a post-mortem analysis, self-analysis and healing as Faulkner (2001) indicates. In these stages, policy responses are aimed at reassessing, repairing and reconstructing the system. In the adjustment stage the new policies will be tested and corrected in the light of experience and new information, whilst in the resolution stage it is supposed that the system has achieved normality or there is a new improved state of the system that may include new established routines.

Since in the recovery phase non-urgent issues are addressed and it involves the reassessment and correctness of policies, actors are not quickly mobilised as in the reaction phase, and the discussion of policy ideas may take a long time. It is in this phase that non-urgent responses are developed and we can expect some delay in their implementation since there is a system of trial and error in the process. It is expected that the responses at this phase will produce long term effects.

However, there may be some cases in which, during the first phases of the crisis, we may expect more incremental than radical changes. Two cases are identified. In the first case this might occur when more radical and non-routine responses are preventively developed in the prevention phase of the crisis (i.e. before the crisis occurs); once the crisis comes they are adapted and applied. In this case, proactive policy learning has taken place. In the second case this might occur when policies that were already developed, but not for the particular crisis, are adapted and applied when the crisis comes. An example of this case is the first outbreak of ISAv in Scotland (United Kingdom) in 1998. At that time the country already had a specific regulation for fish diseases and some measures to deal with ISA. This was because ISA was listed as an exotic disease in List I for the European Union in 1991, and Scotland, as part of the European Union, had to develop some regulation for this. This permitted regulations that were developed in principle to deal with furunculosis[6] in wild salmon in Britain, were adapted for

[6] 'A bacterial disease of salmonids that is usually characterized by boils or furuncles on the skin of affected fish, although this is not always the case. The causative agent is the bacterium Aeromonas salmonicida. Furunculosis is

other diseases in fish farming, such as ISA, and that immediate measures could be implemented to control this disease when it first appeared (McVicar, 2003; Stagg, 2003).

Following the crises phases posed above, after a catastrophic event we may say that there are three types of policy responses to crises: immediate or urgent responses, short-term responses, and long-term responses. The immediate or urgent responses are related to the stabilisation stage (phase two), short-term responses are related to the normalisation stage (phase two), and long-term responses are related to the improvement, adjustment and resolution stages (phase three). In the reaction phase (phase two) the policy reacts to the crisis, whilst the prevention phase corresponds to responses that need to be prepared before the occurrence of the event and allow for proactive policy learning and policy change. In the recovery phase the policy is still reacting to the crisis but attending to problems that have been defined through the discourse of policymaking. The next section discusses the immediate, short-term and long-term policy responses to crises.

2.

systemic in nature as it travels through the bloodstream and affects all parts of the body, especially the vital organs. The rapid multiplication of bacteria in the bloodstream causes smaller blood vessels to rupture allowing the bacteria to spread to surrounding tissue. When allowed to advance to this stage, the disease is always fatal' (http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10950-27389--,00.html Last accessed: 28 May 2013).

The following figure shows the framework about how policy responds through processes of policy learning, and institutional change after dramatic events.

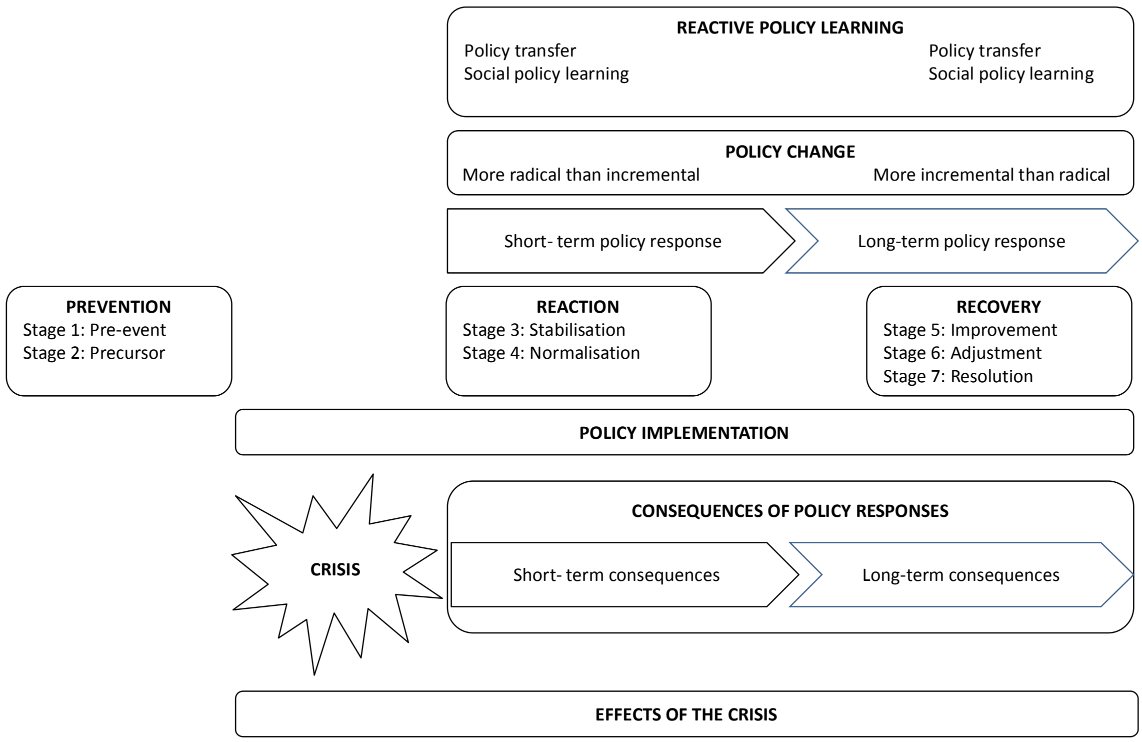

Figure 2.3: Policy learning and policy change framework in the context of catastrophic events
Source: Own elaboration based on Rose (1991), May (1992), Hall (1993), Matland (1995), Faulkner (2001) and Kingdon (2003).

2.5.1. Immediate and short-term policy responses

Following Hall's definition of policy learning and policy change, this research refers to radical policy change as a shift in the policy paradigm. According to Hall, policy paradigms are 'frameworks of ideas and standards that specifies not only the goals of the policy and the kind of instruments that can be used to attain them, but also the very nature of the problems that policymakers are meant to be addressing' (Hall, 1993, p.279). A shift in a policy paradigm is a type of policy change and a form of social policy learning that occurs when the overarching goals that guide policies in a particular field are altered (Hall, 1993). Howlett, Ramesh and Perl (2009) point out that this is an atypical type of policy change whose origins are found outside the formal policymaking process, and in which radical changes are expected.

Hall's paradigm shift is similar to Sabatier's core aspects of a policy which states that '…changes in the core aspects of a policy are usually the results of perturbations in non-cognitive factors external to the subsystem such as macro-economic conditions or the rise of a new systemic governing coalition' (Sabatier, 1988, p.134). However, Sabatier specifies that 'significant perturbations external to the subsystem are necessary, but not sufficient, cause of change in the policy core attributes of a governmental program' (Sabatier, 1998, p.103).

Hall's paradigm shift is also similar to May's (1992) social policy learning, because both concepts are related to the framing of policy and how this framing guides policy actions. For May (1992), social policy learning entails 'a new or reaffirmed social construction of a policy by the policy elites[7] of a given policy domain' (p.337). For May (1992) social constructions represent beliefs, preferences and perceptions over policy aspects such as policy ideas, outcomes and objectives. However, if we consider the interest perspective mentioned by Sanz (1995), social constructions may also represent the interests and priorities of actors over policy aspects. According to May (1992) social learning occurs when 'beliefs among policy elites about key aspects of policy within a given policy domain are either reaffirmed or changed' (p.338). The policy problems, the scope of the policy or policy goals are the central aspects of May's social policy learning. May's social policy learning is similar to Sabatier's policy-oriented learning that refers to 'relatively enduring alterations of thought or behavioural intentions which results from experience and which are connected with the attainment (or revision) of policy objectives (Sabatier, 1988, p.133).

For Hall (1993) a shift in policy paradigm also implies changes of policy instruments and changes in the settings of policy instruments. However, as he indicates, changes in policy instruments and their settings do not imply a change in a policy paradigm. If there is no improved understanding of the policy instruments, the process may lead to superstitious learning, copying or mimicking behaviour, according to May (1992).

Howlett, Ramesh and Perl (2009) criticise Hall's model of policy learning saying that the model is useful but confusing, and the logic of the model would actually lead to four types of policy change rather than three (i.e. policy goals, policy instruments, and setting of policy instruments). Changes referring to the ends of policymaking would correspond to changes in policy goals or programme specifications. Changes referring to the means of the policymaking would correspond to changes of policy instruments and the settings of existing policy instruments. The presence of new ideas and ways of thinking in policy deliberations bring options that address policy goals and instrument types, related to more significant policy

[7] 'The policy elites consist of the governmental actors - elected officials and relevant agency officials - and the leaders of relevant organisations with a continuing stake in the issues that comprise a policy domain' (May, 1992, pp.334-335).

change. Changes in programme specifications and instrument components or settings are more related to the status quo and incremental alterations in policy. For instance, shifts in paradigms or atypical policy changes are facilitated by the entrance of new actors and new ideas into the system.

Thus, shifts in policy paradigms are related to changes in the core aspects of policy. This may occur through changes in the goals of policy through the introduction or consideration of new ideas and beliefs in policies. According to Hall (1993), this implies changes in the policy instruments and settings of those instruments to attain those goals. In the context of crises the conditions under which relevant actors start to consider new ideas in policy, or question the dominant paradigm, occur when exceptional measures and urgent actions are needed to respond in a non-routine way to new problems faced due to the crisis. This usually occurs in the first stages of crises (i.e. reaction phase of the crisis; see page 57). Thus, policy responses at these stages may be expected to be more radical, or potentially radical, than incremental since non-routine measures start to be developed and applied, either from just the local experience or looking at other contexts.

However, as Howlett, Ramesh and Perl (2009) highlight, a crucial factor affecting substantial policy change is the policy subsystem structure. This structure changes with the entrance of new actors who bring new ideas to policy debates. The nature, motivation and ideas of policy subsystems are determinants of the policy alternatives to be considered in the governmental decision agenda, the policy problems to be solved, and the types of instruments to address the policy problems. Hall (1993) and Howlett, Ramesh and Perl (2009) explain that alterations in the policy subsystem structure are related to the fragmentation of authority over policy decisions. Shifts in paradigms are likely to be characterised by conflicting opinions from experts and politicians regarding authority over policy issues, as indicated below.

Apart from the high levels of conflict, ambiguity is also part of a paradigm shift process since actors may understand the policy objectives and policy instruments differently, and there may be confusion and uncertainty in how to use the new policy instruments, their effects and the roles of the organisations related to those instruments (Matland, 1995; Slembeck, 1997).

Based on Hall (1993) and de Vries (2005), Howlett, Ramesh and Perl (2009) propose the characteristics of a general scheme of policy regime change related to a paradigm shift:

- *Regime stability*: the established ideas or views are institutionalised, and the changes in policy are largely made according to this by a closed policy subsystem, and experts and officials close to the policy subsystem.
- *Accumulation of real-world anomalies*: the established ideas and views of the policy cannot anticipate and explain anomalies, and therefore they threaten the effectiveness and legitimacy of those established ideas and views.
- *Experimentation*: the policy subsystem makes efforts to stretch the established paradigm to justify the anomalies.
- *Fragmentation of authority*: experts and governmental officials are questioned, and new actors challenge the existing policy subsystem and paradigm.
- *Contestation*: the discussion of policy ideas involves a larger process, including other arenas.
- *Institutionalisation of a new regime*: after a while, the advocates of a new regime gain authority positions in the decision making, and shift the existing agreements in order to institutionalise the new paradigm.

In the context of an industry natural resource crisis it is possible to say that the crisis causes unusual problems that disrupt the industry governance processes of the industry, including the established industry regulatory framework (i.e. the regular way in which the industry operates). This disruption challenges the industry policy paradigm allowing the entrance of new participants and new ideas. The disruption of industry governance processes causes conflict among actors allowing the opportunity to change or reorder their interests, priorities and power. It may also introduce substantial ambiguity in policy processes and policy outcomes due to the novelty of the ideas, the possible lack or uncertainty of resources, or uncertainty in the effectiveness of the results to be achieved. Conflict and ambiguity may trigger processes of negotiation among actors over policy processes and policy outputs. Considering radical policy changes in the context of natural resource crises is important because shifts in policy paradigms may change the direction of the management, control and access of the resource, which may reorder the interests and power of involved actors.

Part of the analysis of this research will look at whether the sanitary crisis in the Chilean salmon industry as an exogenous stimulus disrupted the industry governance processes, and whether the immediate and short-term responses to the crisis led to a paradigm shift in the industry.

2.5.2. Long-term policy responses

Following Hall's definition of policy learning and policy change, this research refers to incremental policy change as the changes in policy instruments, and changes in the setting of policy instruments, without changes in the goals or scope of policy (i.e. paradigm shift). Policy responses to crises related to incremental policy change may take the form of new or amended policy instruments and their settings. This definition may be related to May's instrumental policy leaning as 'new understandings about the viability of policy interventions or implementation designs' (May, 1992, p.335). While Hall (1993) points out that alterations to policy instruments and their settings are improved or changed to achieve the policy goals, May (1992) states that instrumental learning does not need to be goal oriented.

When incremental policy change takes place, superstitious learning, copying and/or mimicking behaviour (concepts pointed out by May, 1992) may also occur if there is no improved understanding of the new or amended policy instruments. Howlett, Ramesh and Perl (2009) point out that more incremental changes in policy are in the more formal policymaking process as opposed to processes of paradigm shifts.

As Hall (1993) indicates, the conditions under which incremental policy change are most likely to occur in the context of crises, is when more radical, or potentially radical, responses have already been developed and they need to be adjusted and improved in the light of experience and new information. This usually occurs when the urgent issues of the crisis have already been addressed and the system goes to achieve normality.

To consider incremental policy changes in the context of natural resource crises is important, because changes in instruments and their settings from experience and new information may make those instruments more technically and politically feasible, and therefore more implementable towards addressing the crisis, the problems revealed by it and thus avoid a future crisis. Hall's categorisation of policy change as changes in policy instruments or settings of policy instruments is useful to know and understand when there were alterations or creation of instruments and/or adjustments in their settings. However, the simplicity of this categorisation does not allow the observation of a relationship pattern that might be useful to anticipate advantages and disadvantages, difficulties and facilities in the application of certain instruments over others, know where the actors' capacity and capabilities are placed, and, finally, the consequences of the decision to design and apply certain instruments over others. A way to cope with this is to know a general variety of instruments that can be outcomes of the policy change process. Howlett, Ramesh and Perl (2009) present a policy instrument taxonomy adapted from Hood (1986) that may benefit Hall's categorisation of policy change. The following table presents this taxonomy.

Table 2.5: Instruments taxonomy

Instruments Taxonomy	
Nodality or information-based instruments	Public information campaigns
	Exhortation
	Benchmarking and performance indicators
	Commissions and inquiries
Authority-based policy instruments	Command-and-control-regulation
	Delegated or self-regulation
	Advisory committees
Treasure-based policy instruments	Subsidies: grants, tax incentives, and loans
	Financial disincentives: taxes and user charges
	Advocacy, interest groups, and think-tank funding
Organisation-based policy instruments	Direct provision
	Public enterprises
	Quangos
	Partnerships
	Family, community and voluntary organisations
	Market creation
	Government (re)organisations

Source: Howlett, Ramesh and Perl (2009).

Howlett, Ramesh and Perl (2009) state that nodality or information-based instruments are those policy instruments that involve the use of resources related to the information available to governments. Authority-based policy instruments are those policy instruments through which governments use their authority to reach their targets. Treasure-based policy instruments refer to the financial resources of governments and their ability to raise and distribute funds. Finally, organisation-based policy instruments refer to policy instruments that impact governmental organisation, for example, changes in the bureaucracy and the creation of public firms.

This section has discussed policy responses related to policy learning and policy change, which is summarised in the following table. It was argued that, in the reaction phase of crises, it is most likely to expect more radical, or potentially radical, changes in policy, as opposed to the recovery phase during which more incremental changes are most likely to occur. Depending on the context, policy learning may adopt a more positivist or constructivist approach. Immediate, short and long term responses to crises may have different consequences for industry actors and society: this is the topic of the next section.

Table 2.6: Policy responses along the evolutionary phases of crises

Crisis phase	Crisis stages	Description of the crisis stages	Policy change (Normal or atypical)	Policy learning
Reaction	Stabilisation	The point of no return when the crisis has hit and damage limitation is the main objective. When the immediate effects of the crisis have been felt and rapid actions have to be taken	Immediate and short-term policy responses: More radical, or potentially radical, responses linked to paradigm shift (overarching goals that guide policies are altered)	Social policy learning Policy transfer More positivist approach More constructivist approach
	Normalisation	When short-term needs of the affected community must be dealt with. The objective at this point is to restore the system to normality as quickly as possible		
Recovery	Improvement	Continuation of the normalisation stage, but items that could not be addressed quickly are attended to at this point	Long-term policy responses: More incremental responses (changes in policy instruments, and changes in the setting of policy instruments, without changes in the goals or scope of policy)	Social policy learning Policy transfer More positivist approach More constructivist approach
	Adjustment	New policies and implemented actions to deal with the crisis are tested and corrected in the light of experience and new information		
	Resolution	Routine restored or new improved state of the system		

Source: Own elaboration based on Faulkner (2001), Sabatier (1988), May (1992) and Hall (1993).

In the literature, policy responses to crises exemplify the approaches and types of responses taken by governments to face dramatic events. For example, Jacob and Hellström (2000) and van Zwanenberg and Millstone (2001) report on the Bovine Spongiform Encephalopathy (BSE[8]) crisis in United Kingdom in the 1990s. They argue that the British government did not take a precautionary approach to respond to the crisis, even though the BSE disease appeared several years ago in the cattle industry. When the epidemic began, the government needed to make immediate and urgent decisions in the short term. Regulations came in the long term and they were considered as late responses. It was a criticism that few resources were invested in scientific research and that the participation of scientists was discouraged. Van Zwanenberg and Millstone (2001) point out that policies responded to a political rationale in the first place, and the goals of those responses were to reduce the negative impact of the disease on the profitability of the industry. Moreover, controls of the disease were not aimed at its eradication but to reduce the risk of the disease.

In the case of the Fukushima nuclear disaster that occurred in 2011, Hayashi and Hughes (2013) discuss the short- and long-term policy responses to this disaster and the effects of those policies on energy security in Japan. They explain that the short-term measures taken by the government helped to avoid blackouts in the country, although other sources such as fossil fuel increased the cost of the electricity. The long-term measures produced a dramatic shift in Japan's nuclear policy and they gave the opportunity to promote renewable energy. Fukushima's accident is an example of how policies applied in a country may influence the development of policies in other contexts; it is also a case from which to learn about energy security policy.

Even though the two crises mentioned above are good empirical examples of policy responses to dramatic events, they differ from the case study employed in this thesis (policy responses to the ISA crisis in the Chilean salmon industry) due to the nature of the crises and the types of resources involved in those crises. A key issue to develop the policy responses in the Chilean case was the intensive exploitation of a natural common-pool resource (water), which produced in the policy making process a high level of conflict and different consequences from the measures for the distinct actors who were users of the common resource.

[8] 'Bovine Spongiform Encephalopathy (BSE) also known as 'Mad Cow Disease' is a chronic degenerative disease affecting the central nervous system of cattle' (Jacob and Hellström, 2000 pp.303).

2.6. Consequences of policy responses to crises

This section helps to answer the third research question of this study. It is related to the results caused by policy responses stimulated by crises for industry participants and society. To answer this question, first, how conflict and ambiguity have an effect on evolutionary processes of policy learning and policy change triggered by catastrophic events is explained, including the evolution of policy responses according to the conflict and ambiguity. Second, short-term consequences of policy responses are distinguished from those in the long-term to give a more comprehensive analysis of industry policy learning and policy change.

Conflict and ambiguity are two features inherent in the policymaking process and have been central to explaining models of decision-making such as the rational and incremental models (e.g. Allison, 1969 and Lindblom, 1959). We argue that the conflict and ambiguity over policy issues can be observable at each stage of the crises, and that the consequences of the process and outcomes of policy responses to industry natural resource crises can be examined from a conflict and ambiguity perspective. Also, that policy learning is not a neutral process based solely on the role of ideas and knowledge, but one strongly influenced by the power relationships among actors.

As discussed by Matland (1995) and Slembeck (1997), conflict over policy issues emerge when there is incompatibility of policy goals, interests, values and activities, disagreements over policy means, and restriction on the behaviour of the addressees. Ambiguity emerges when there are misunderstandings or uncertainty in policy goals, policy instruments and the settings of the policy instruments, when different actors interpret the goals or instruments of policy differently, when there is misunderstanding or uncertainty in the role of actors, uncertainty in the capability or capacity and resources to reach policy goals or implement policy instruments, and when there is ambiguity in the language of policy.

We argue that both conflict and ambiguity over policy issues have diverse sources and they evolve over time along the phases of the crises. They change as actors' knowledge, interests and values of problems and options evolve over time and through experience (see pages 52-53). Although knowledge and interests are more variable, actors' values and beliefs may be more stable.

Conflict and ambiguity are often seen as negatively correlated; as Matland (1995) points out, ambiguity is a way to limit conflict. As long as the policy goals are diffuse the levels of conflict will be low. The clearer the goals are the more likely it will be that they lead to conflict

(Matland, 1995). As seen in Section 2.4.3, interests and understandings of actors change over time and, after a period, conflict again emerges according to the specific interests and understandings of actors at that point in time. To reduce the conflict, the ambiguity will be increased, which after a while will again cause conflict.

In policy responses to crises, conflict and ambiguity can be observable during each of the evolutionary phases of crises. For instance, in the stabilisation stage the urgency 'to do something' to address the crisis may lead to high ambiguity and low conflict on the immediate policy responses to be developed and implemented. However, when the urgency is over and the actors have gained some experience in implementing the responses, the ambiguity will decrease while conflict may increase due to the interests of actors having changed over the framing of new issues that arise at that point in time. This dynamic between ambiguity and conflict may be repeated through all the stages of crises. Conflict and ambiguity re-emerge over time and change the direction of policy responses, stimulating further industry policy changes and continuing with the industry policy learning process.

In his attempt to synthesise the policy implementation literature, Matland (1995) developed a conflict and ambiguity model in which, depending on their intensity (low or high), conflict and ambiguity lead to different types of policy implementation. Policy learning and policy change literature may take advantage of this model and adapt it to explain the consequences of policy responses through the policy learning process triggered by catastrophic events. The following table shows the characterisation of policy consequences from policy responses.

Table 2.7: Conflict and ambiguity from policy responses

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Conflict:
- Incompatibility of policy goals, interests, values, activities
- Disagreement over means
- Restriction of the behaviour of the addressees</td></tr>
<tr><td>Low</td><td>High</td></tr>
<tr><td rowspan="2">Ambiguity:
- Misunderstanding and/or uncertainties in policy goals, instruments, instrument settings
- Different interpretations of policy goals, scope and/or instruments
- Misunderstanding and/or uncertainties in the role of actors
- Uncertainty in capability and/or capacity and resources to reach policy goals and/or implement policy instruments
- Ambiguity in policy language</td><td>Low</td><td>Straightforward policy responses</td><td>Emergence of divisions among actors over policy responses</td></tr>
<tr><td>High</td><td>Vague policy responses that are not contested by actors</td><td>Chaotic policy responses</td></tr>
</table>

Source: Own elaboration based on Matland (1995) and Slembeck (1997).

Policy responses have consequences that can be mapped in the conflict and ambiguity perspective matrix posed above at different points in time (e.g. short and long term). The evolution of the dynamic of conflict, ambiguity and their interrelation along the evolutionary phases of crises through changes in policies is visualised as the movement of a consequence from one quadrant to another. Like policy responses, their consequences can be categorised into short-term consequences and long-term consequences. Following the crises phases posed in the previous section, by definition, immediate and short-term consequences are related to the reaction phase (i.e. stabilisation and normalisation stages), and the long-term consequences are related to the recovery phase (i.e. improvement, adjustment and resolution stages); this will be discussed in the next section.

2.6.1. Short-term and long-term consequences of policy responses

In the short-term, during the reaction phase of crises, actors develop policy responses to address the urgent and short-term problems caused by the crisis. Conflict and ambiguity may emerge from the design of those responses. Since mainly at the beginning of the crisis urgent responses are required and rapid action has to be taken, it may be expected that those responses will be designed and decided by a close group of actors excluding others with the belief of rapidly reaching consensus. In situations with low degrees of conflict, the close group of actors can take decisions that other actors will accept because they are effectively representative of those who are not included. However, in situations with high conflict the need for a close group of actors may cause conflict due to disagreements and lack of consensus over policy responses that have been decided by others, and which affect their interests and values. Moreover, ambiguity over policy means (e.g. resources), how to address the crisis and over policy instruments may also be expected to influence short-term consequences.

In the long-term, during the recovery phase of crises, it is supposed that the system moves to restore its normality. As was pointed out earlier, normality is an ambiguous concept (see page 59), and it will depend on how different actors understand it. It may include the routinising and updating of policy instruments, governance processes, and balancing the interests of actors that were destabilised by the crisis. Moreover, normality, for some actors, may also involve the process of reducing the ambiguity of policy instruments. For example, it may be required that all actors understand the new policies in the same way as they were intended, to ensure capacity and resources to put the policy responses into practice, that actors and organisations are clear about their roles, and that the language of the policy and instruments is clear. However, the reduction of conflict and ambiguity of policy responses could not always be achieved.

Conflict and ambiguity, as noted by Matland (1995), are crucial in implementing policy. Difficulties in putting policy into practice can be found in both the short and long term responses. In the context of crises, since especially at early stages of crises policy responses may be more radical, or potentially radical, to address the non-routine problems, it is expected to find more difficulties in implementing those responses. From a conflict-ambiguity perspective, Slembeck (1997) points out that difficulties in putting policies into practice and implementing them in the same way as they were intended may be caused by principal agent problems[9], while Kingdon (2003) notes that this also may be due to the technical and political infeasibility of policies.

[9] 'Conflicts of interest and moral hazard issues that arise when a principal hires an agent to perform specific duties that are in the best interest of the principal but may be costly, or not in the best interests of the agent. The principal-agent problem develops when a principal creates an environment in which an agent has incentives to align its interests with those of the principal, typically through incentives. Principals create incentives for the agent to act as the principal wants because the principal faces information asymmetry and risk with regards to whether the

Kingdon (2003) also states that some difficulties in putting the policy into practice are a consequence of unsolved points during the period during which policies have been designed. These points are those in which actors did not reach agreement and therefore the conflict was passed to the implementation stage. Problems in putting policies into practice call for further changes in policies in order to adjust them to what is workable and politically acceptable, and actors will try to negotiate and influence the implementation and adjustments of policies.

To summarise, it was argued that conflict and ambiguity is a suitable perspective to explain the consequences of policy responses to crises since both the conflict and the ambiguity can be observed over the stages of crises. In the short-term, it is likely that conflict and ambiguity emerge from the design of the policy responses, while in the long-term they will emerge in the process of routinisation of policy. Conflict and ambiguity may be found in the implementation of policy responses due to a variety of reasons, both in the short and long term.

2.7. Evidence of policy learning and policy change and the closing of the policy window

Policy responses and their consequences may give convincing evidence of changes in policies responding to industry natural resource crises. However, whether those changes produce learning is contestable and depends on the interests, understandings and beliefs of different actors. This section discusses how evidence about policy learning and policy change can be developed, and how it might complement the answers to the second and third research questions of this study. Birkland (2006) points out that tangible evidence of policy change constitutes new legislation, new regulation and modifications in regulations or standards. Thus, amendments to legislation, creating updated versions of legislation, are also evidence of policy change. However, legislation that has been passed and published does not mean that learning has actually taken place.

According to Birkland (2006) it is difficult to observe outcomes of policy learning if this process is not accompanied by policy change: however, changes in policies can also occur without learning. May (1992) argues that, for instrumental learning, this occurs when policy instruments or implementation designs have been modified without an improved understanding of those instruments and designs. He refers to this as superstitious learning, copying or mimicking behaviour. For May (1992), *prima facie* evidence of instrumental learning

2.

agent has effectively completed a contract' (http://www.investopedia.com/terms/p/principal-agent-problem.asp Last accessed: 10 September 2014).

would be the redesign of the policy involving changes in the policy instruments, whilst for social policy learning, *prima facie* evidence of learning constitutes the redefinition of the policy goals or policy scope.

Relating to dramatic events such as crises, Birkland (2006) points out that 'there is prima facie evidence of learning if policy changes in a way that is reasonably likely to mitigate the problem revealed by the focusing event' (p.22). Moreover, that there is learning when there is a high probability that changes in policy mitigate the problems caused by the focusing event. In the case where policy learning was triggered by policy failure, it is said that learning has occurred 'when the proximate causes of the policy failure revealed by the event are subsequently addressed by changes in policy' (Birkland, 2006, p.166). However, different actors may understand differently and disagree on the problem(s) revealed by the crisis. This may lead to some actors seeing that changes in policy do not actually mitigate the problem(s), and that superstitious learning or mimicking behaviour has taken place instead of learning.

As will be seen later in Chapter 7, this was the case in the salmon industry in Chile where changes in policies following the sanitary crisis were seen by some actors (e.g. NGOs) as mimicking behaviour by the Chilean industry in respect to other salmon industries (see section 3.2), who implemented measures to deal with ISAv before Chile. The following table presents the typical evidence of learning in the policy process.

Table 2.8: Typical evidence of learning in the policy process

Organisation or Institution	Evidence of Learning
News media	Stories about the problem Changes in the nature of news coverage (people quoted, substance of news coverage)
Interests groups	Changes in appearances at congressional hearings Increased attention from news media (generated by the group)
Congress	Legislative change Change in the substance of debate Change in the topic areas of hearings
Regulatory and implementing agencies	Issuance of new and proposed regulations Change in nature and substance of the regulation being issued Change in procedures and in the interpretation and implementation of statutes and regulations

Source: Birkland (2006).

Regarding the closing of the policy window, Kingdon (2003) points out that the policy window may close for a variety of reasons, including:

- Actors believe that if they made a decision or enacted legislation then they have addressed the problem;
- Actors are not getting attention to make changes, decisions or enact legislation and therefore they are not willing to continue investing time and energy on it;
- The events that opened the window are no longer relevant;
- There are no available alternatives to deal with the problem(s);
- A turnover of relevant actors that opened a window is followed by another turnover of actors.

In the case of crises, since the policy window is opened by defining the crisis as policy problem, the policy window may be closed if actors believe that by enacting legislation they have addressed the crisis, if the crisis is no longer a relevant issue, or if there are no solutions available to solve the crisis. Also it is possible to think that the policy window may close if there is a turnover of the actors that defined the crisis a as policy problem and the incoming actors do not believe that the crisis is a problem to be faced by them.

To summarise, evidence of industry policy learning and policy change will depend on the type of policy learning taking place. For instrumental learning, *prima facie* evidence of learning would be changes in the policy instruments, whilst for social policy learning that would be redefinitions of policy scope or policy goals. Policy change may take place without learning; May (1992) refers to this as superstitious learning, copying or mimicking behaviour. In the case of catastrophic events, Birkland (2006) points out that the mitigations of the problems revealed by the event may constitute *prima facie* evidence. However, this may be contestable if actors disagree on the problems revealed by the event. On the other hand, the policy window opened by crises may close for a variety of issues, all of them related to the interpretation, interests and beliefs of actors in addressing the crisis.

2.8. Research questions

This research draws on the case of the regulatory reform in the Chilean salmon farming industry stimulated by a sanitary crisis that the industry faced between 2007 and 2010. The research questions that this research will answer are:

- How do industry natural resource crises precipitate processes of policy learning and policy change?

This question is focused on how the sanitary crisis of the industry accelerated the processes of policy learning and policy change. It has been argued that industry natural resource crises, such as the sanitary one that affected salmon farming in Chile, become windows of opportunity to enact policy changes that with the time and experience gained by the actors may be seen as radical or incremental. The underlying question is what was the nature of the policy change triggered by the opening of this policy window?

- How are policy responses stimulated by industry natural resource crises developed and implemented?

This question is focused on how actors respond to an industry natural resource crisis through processes of learning linked to institutional change, and how those policy responses are put into practice. It has been argued that crises, such as the sanitary one of the Chilean farming industry, are events that evolve over time through different phases. This suggests that policy learning and policy change stimulated by crises are also dynamic processes that evolve, perhaps in distinct ways, throughout the phases of crises. The underlying question is how do policy responses triggered by crises progress?

- What are the consequences of policy responses stimulated by industry natural resource crises for industry participants and society (e.g. local environment and jobs)?

This question is focused on the effects of policy responses to crises by different actors. It is argued that consequences of responses to crises, such as those in the Chilean salmon industry, can be examined by employing a conflict and ambiguity perspective. The underlying questions are, what are the features that have an effect on dynamic policy learning and policy change processes triggered by crises, and how the policy responses evolve over time according to these features?

2.9. Synthesis of the chapter

This research contributes to the policy learning literature and is concerned with how actors respond to an industry natural resource crisis through the processes of learning linked to institutional change. It draws on the case of the regulatory reform in the Chilean salmon farming industry stimulated by a sanitary crisis, and argues that the process of policy learning in the context of crises is very different from the process of policy learning in their absence. The study is guided by three research questions, and to answer them the policy learning and policy change literature and the literature related to crises and disasters management are bridged. Although in the policy learning and policy change literature there are several conceptualisations of policy learning, this research uses policy learning in the social policy learning conceptualisation context made by Peter Hall, where changes in policy may occur at the levels of the setting of policy instruments, policy instruments or policy goals.

The first research question of the study is related to the role of industry natural resource crises as policy learning and policy change precipitators. In the literature, crises are considered as focussing events, seizing the attention of policymakers and raising the issue in the governmental decision agenda, and as policy windows providing opportunities to push attention on specific problems. It is argued that crises may also act as precipitators of policy learning and policy change pushing sudden changes in policy and providing actions on specific initiatives where major changes may occur.

The second research question is related to the development and implementation of policy responses triggered by industry natural resource crises. In the development of responses it is argued that causes of crises may inform a more general analysis of the definition of problems to be faced by policymakers, and that those causes may guide the design of policy responses to address them. Explanations about causes of the crises depend on the narratives that relevant actors construct, which are based on how the actors understand and interpret failures related to the crises, and make causal links to translate those failures into policy problems. Policy responses may diverge due to the existence of a variety of narratives. In complex ecological systems such as salmon farming, the origins of an industry natural resource crisis cannot be attributed to just one cause due to the multiple interdependence of failures.

To explain causes of natural resource crises this research has proposed an adaptation of the system failure approach with the addition of a category to consider unexpected failures, which are crucial to ecological systems. This approach has been proposed as an alternative to traditional explanations of resource crisis, such as Hardin's tragedy of the commons and Ostrom's collective action theory. It is argued that the proposed approach offers a more complete analysis to explain natural resource crises since it adopts a more holistic perspective involving different interrelated factors that may play a role in those crises. Moreover, it considers a more complete set of actors, institutions and their relationships that may play a role in causing an industry natural resource crisis.

Responses that are prepared before the occurrence of the event allow for proactive policy learning and policy change. However, if they have not been developed prior to the event, policies react to crises. It is argued that policy responses to crises are also guided by the characteristics of crises, and that crises are dynamic, enduring and persistent events with evolutionary phases that create a dynamic process of policy learning and policy change. This is opposed to how the literature considers crises, as focussing and stagnant events that last for a relatively short period. Crises seen as dynamic events imply that policy responses are developed and delivered in different stages. Policy responses may be classified into immediate or urgent responses, short-term responses and long-term responses. When policies react to crises it is most likely to expect more radical, or potentially radical changes, in policy, as opposed to later stages of the crises in which more incremental changes are most likely to occur. Depending on the context, policy learning may adopt a more positivist or constructivist approach.

The third research question is related to the consequences of policy responses to industry natural resource crises for industry participants and society. Policy responses may have short and long term consequences. It is argued that conflict and ambiguity is a suitable perspective to explain these consequences, since both the conflict and the ambiguity can be observed over the stages of crises. In the short-term, it is likely that conflict and ambiguity emerge from the design of the policy responses, while in the long-term they will emerge from the process of routinisation of policy. In the short and long term, for a variety of reasons also linked to conflict and ambiguity, it may be difficult to implement the policy responses in the same way as they were intended.

Evidence of policy learning and policy change will depend on the type of policy learning taking place. For instrumental learning, *prima facie* evidence of learning would be changes in the policy instruments, whilst for social policy learning that would be redefinitions of policy scope or policy goals. Policy change may take place without learning, thus constituting superstitious learning, copying or mimicking behaviour. Finally, the policy window opened by crises may close for a variety of issues, all of them related to the interpretation, interests and beliefs of actors in addressing the crises.

CHAPTER 3

THE SANITARY CRISIS IN THE CHILEAN SALMON FARMING INDUSTRY

"During the winter of 2007, unexplained mortalities were registered in market-size Atlantic salmon in a grow-out site located in Chiloé in Region X of Chile"

(Godoy et al., 2008)

This chapter outlines the history of the infectious salmon anaemia virus in farmed Atlantic salmon in Chile, which caused the sanitary crisis in the Chilean salmon farming industry. The first part of the chapter mainly explains the nature of the infectious salmon anaemia, how ISAv has affected the Norwegian, Canadian and Scottish industries, the susceptible host species and carriers, and the mechanisms of transmission. The second part of the chapter reviews the spread of infectious salmon anaemia in Chile and the onset of the sanitary crisis in the salmon farming industry. The third and last part of the chapter examines the impacts of the crisis.

3.1. Infectious salmon anaemia

The Infectious Salmon Anaemia (ISA) is a viral disease of farmed Atlantic salmon (salmo salar) produced by the infectious salmon anaemia virus (ISAv). ISAv belongs to the genus Isa virus in the Orthomyxo viridae family (Nylund *et al.*, 1997).

ISAv develops mainly at the stage of the salmon's life spent at sea. It does not affect other fish, molluscs or sea products (Subpesca and SalmonChile, 2008), and is not able to survive in human beings[10] (European Commission, Health and Consumer Protection Directorate-General, 2000). In freshwater, horizontal transmission of the disease has been achieved experimentally (Brown *et al*., 1998 quoted by Cipriano and Miller, 2003, p.4), and a rapid transmission of the virus has been observed between infected fish and non-infected smolts (young fish that have not been in contact with the virus); asymptomatic fish may still infect naïve parr (young salmon over a year old) 18 months after the original exposure (Griffiths and Melville, 2000).

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[10] Gastric pH in humans does not allow the activation of the virus (Hastings, 1998; Torgersen, 1993; Eliassen *et al*., 2000), since the virus presents its maximum levels of replication at 15°C. It does not replicate at temperatures of 25°C or above; a corporal temperature in humans of 37°C means that the virus cannot replicate (Falk *et al*., 1997; Hastings, 1998). The virus has been present in other salmon producers who have continued exporting salmon without evidence of adverse effects in human health on people consuming the salmon, or people working in aquaculture (Hasting, 1998).

ISAv was first recorded in autumn 1984 in a farming centre on the south-west coast of Norway. Outbreaks are characterised by severe anaemia, a chronic course of the disease and high mortality (Thorud and Djupvik, 1988). The mortality caused by ISAv may vary in different farming centres and in the same farming centre. A common daily mortality of between 0.5% and 1% is characteristic in affected cages that may increase overtime. In severe cases, cumulative mortality may exceed 90%. When no measures to control the disease are taken, it seems that mortality increases and peaks in early summer and winter (World Organisation for Animal Health, 2012).

Since its first appearance in Norway in 1984, the virus has been reported in Canada (New Brunswick) in 1996 (Byrne *et al*., 1998; Mullins, Groman and Wadowska, 1998), United Kingdom (Scotland) in 1998 (Rodger *et al*., 1998), Canada (Nova Scotia) and the Faroe Islands in 1999 (Lyngøy, 2003), United States (Maine) in 2001 (Bouchard *et al*., 2001; Miller, 2003), and Ireland in 2002 (Rolland and Winton, 2003). In Chile the virus was recorded in 1999 and 2007 (Kibenge *et al*., 2001; Godoy *et al*., 2008). See next section.

World Organisation for Animal Health (2012) points out several susceptible host species[11] for the virus. Natural outbreaks have been reported just from farmed Atlantic salmon; however, the virus has also been isolated from rainbow trout in Ireland in 2002 and Coho salmon in Chile in 1999. Also, wild species such as Atlantic salmon, brown trout and sea trout (S. trutta) have been identified with the virus. Experimental infection of other species (such as Artic char (Salvelinus alpinus) and Atlantic cod (Gaduos morhua)) has demonstrated the replication of the virus (Plarre *et al*., 2005). The disease infectious salmon anaemia is listed in the Aquatic Animal Health Code of the World Organisation for Animal Health, and therefore control measures should be implemented by the countries in which ISAv exists (World Organisation for Animal Health, 2012).

It has been found that the disease spreads horizontally by salmon lice (Caligus elongates and Lepeophtheirus salmonis) from one farm to another (Nylund, Wallace and Hovland, 1993), organic material via skin (e.g. mucous membrane and abrasions), urine and faeces (Nylund, Wallace and Hovland, 1993), animal waste, effluents (blood or somatic cells or organic particles infected with the ISA agent) from farms and slaughter plants (Vågsholm *et al*., 1994),

[11] 'Susceptible species means a species of aquatic animal in which infection has been demonstrated by natural causes or by experimental exposure to the pathogenic agent that mimics the natural pathways for infection'. Glossary of Aquatic Animal Health Code (OIE, 2012. Available at: http://www.oie.int/index.php?id=171&L=0&htmfile=glossaire.htm#terme_manuel_aquatique Last accessed: 9 December 2012).

passive transmission in seawater and blood from fish processing plants (Nylund, Wallace and Hovland, 1993; Jarp and Karlsen, 1997). Blood and mucous contain large amount of the virus and may transmit the disease more effectively than faeces, plankton and salmon lice (Rolland and Nylund, 1998 quoted by Cipriano and Miller, 2003, p.4). In virulence experiments, blood was found the most infectious element in passive transmission. Sea lice are suggested as a vector[12] since they feed on the blood of the salmon (Stagg, 2003).

World Organisation for Animal Health (2012) points out that it has been suggested that the spread of the virus may be via transportation of smolt, which could be infected prior to shipping, or by wellboats (specialised boats with tanks for the transport of live fish) contaminated with ISAv. In this way the virus can be spread over long distances. Wellboats may be contaminated by the transport of infected fish, or from taking water from areas contaminated with the virus (Murray, Smith and Stagg, 2002). Along the same lines, Nylund *et al*. (1997) point out that the spread of the virus in Norway can be explained by the transport of infected salmon. It has been demonstrated that the virus is still viable in infected salmon fillet (muscle) after being kept at -20°C and thawed. For this reason it is important to eliminate the virus before the fish is sold or transported. Therefore there is a risk in exporting Atlantic salmon from areas where the virus exists to other producer countries of Atlantic salmon. Other proposed significant risk factors are the use of smolt from different suppliers (Jarp and Karlsen, 1997) and contact with contaminated equipment or equipment from individuals handling infected fish (Subpesca and SalmonChile, 2008).

Vertical, or transgenerational, transmission has also been suggested for the spread of the virus in the Norwegian (Nylund *et al*., 2007) and Chilean (Vike, Nylund and Nylund, 2009) industries. Based on the mechanisms of transmission mentioned above, some disease control measures that have been proposed involve having one fish generation per site, maintaining a minimum distance in grow out sites for Atlantic salmon, and preventing smolt production in lakes at risk of ISAv. The distance in grow out sites can be different for each area according to currents and environmental factors (Vike, Nylund and Nylund, 2009). A minimum distance of 5 Km between aquaculture units is suggested in order to reduce the spread of the virus through the water, since passive transmission may occur over 5-10 Km after 6-12 months. Therefore separation of areas with different status of ISAv is needed.

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[12] 'An organism that transmits the causative agent or disease-causing organism from the reservoir to the host' (http://www.biology-online.org/dictionary/Vector Last accessed: 28 May 2013). Epidemiologically speaking, carrier and vector are synonyms.

Also, oceanographic studies should be conducted to understand the relationship between the location of sea sites and the spread of the virus through the water better. Disinfecting water coming from slaughterhouses and processing plants is also suggested. It has been found that the risk is greater when the water is not disinfected. There are different systems or methods to disinfect water and inactivate the virus. Treatments with heat, sodium hydrochloride, ozone, or ultraviolet radiation quickly reduce the infectivity, whilst treatments with formic acid or sodium hydroxide require more time to be effective (Vågsholm *et al*., 1994; Jarp and Karlsen, 1997). World Organisation for Animal Health (2012) suggests the use of UV irradiation and ozone as effective inactivation methods since the virus is sensitive to this.

Since some studies have shown that ISA transmission is related to aquaculture practices (World Organisation for Animal Health, 2012), in addition to the earliest diagnosis of the virus, and after the disease has appeared, biosecurity measures should be implemented (Vågsholm *et al*., 1994) to depopulate the site without delay (Jarp and Karlsen, 1997). World Organisation for Animal Health (2012) suggests the disinfection of eggs according to standard procedures as an important control measure. In order to control the disease and its prevalence, the implementation of measures via regulation or husbandry practices on the movement of fish, mandatory health control, transport and slaughterhouse activities is also suggested. Specific suggested measures are restrictions in all types of farms (i.e. affected, suspected and neighbouring), enforced slaughtering, all-in-all-out[13] and disinfection of disposal material (e.g. offal and water) from slaughterhouses and processing plants.

In 2001 commercial vaccines against ISA became available (Rolland and Winton, 2003). However, vaccination as an effective measure has been questionable since it seems that those available do not offer complete protection in Atlantic salmon (World Organisation for Animal Health, 2012). Kibenge *et al*. (2004) note vaccines also may act as virus carriers.

Nylund *et al*. (1997) report that experiments have been conducted in laboratories to find out if ISAv can be propagated in other species different from Atlantic salmon, for example, rainbow trout (Oncorhynchus mykiss). They conclude that the virus can be replicated and propagated in this specie and that this specie can act as a reservoir[14]. However, it seems the virus does not cause significant mortalities. The lack of mortality can suggest that the virus can be present in

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[13] 'Each production site is limited to only one generation of salmon' (http://salmon-from-the-faroe-islands.com/all+in+all+out.html Last accessed: 28 May 2013).

[14] 'A reservoir host or reservoir of infection, an alternate or passive host or carrier that harbours pathogenic organisms, without injury to itself and serves as a source from which other individuals can be infected' (http://www.biology-online.org/dictionary/Reservoir Last accessed: 28 May 2013).

the host for a long time and therefore this specie can act as a carrier. They also point out that experiments have demonstrated that the virus can be propagated in salmo trutta (salmon trout). Nylund *et al*. (1997) stress that it is crucial to know whether the virus can be propagated and persist in other species with the aim of improving the management of the disease in Norway, and the spread of the virus to other countries. On the other hand, Kibenge *et al*. (2001), Rolland and Winton (2003) and Plarre *et al.* (2005) report that, in wild species, ISAv usually produces an asymptomatic infection and for that reason these species can also be reservoirs of the virus.

Rolland and Winton (2003) stress the importance of determining the risk of Pacific salmon (they involve several species among them there is Coho salmon) being affected by ISAv in order to prevent a potential introduction of the disease into western North America. This is because ISAv is a major disease in Atlantic salmon and there is an increased international movement of fish. It was shown that Pacific salmon are considerably more resistant than Atlantic salmon to ISAv, and apparently Pacific salmon are at low risk in terms of the spread of ISAv to the western areas of North America where these species are generally found. Because of this, the study suggests that Pacific salmon are good aquaculture alternatives in places where ISAv is present.

3.2. Infectious salmon anaemia in the world

As mentioned in the previous section, the ISAv has existed in the world since 1984. The first countries experiencing the virus were Norway, Canada and the United Kingdom (Scotland). A brief account of each of these country's experience is as follows:

<u>Norway</u>

Thorud and Håstein (2003) and Lyngøy (2003) report that the first outbreak of ISAv appeared in the southern part of Norway in 1984, in a farm located in Hordaland County. Later on other farms that received smolts from the original infected farm experienced similar outbreaks. The counties of Hordaland and Sognog Fjordane were the first to be affected. Between 1997 and 2002, 56% of the total Norwegian outbreaks were reported by these counties. In the north of Norway the disease appeared in 1988, although it is believed that there was a case in 1986 but it was not diagnosed. The following figure shows the number of sites subject to restrictions due to ISA diagnosis in total, and in the counties of Hordaland and Sognog Fjordane (the first counties to be affected).

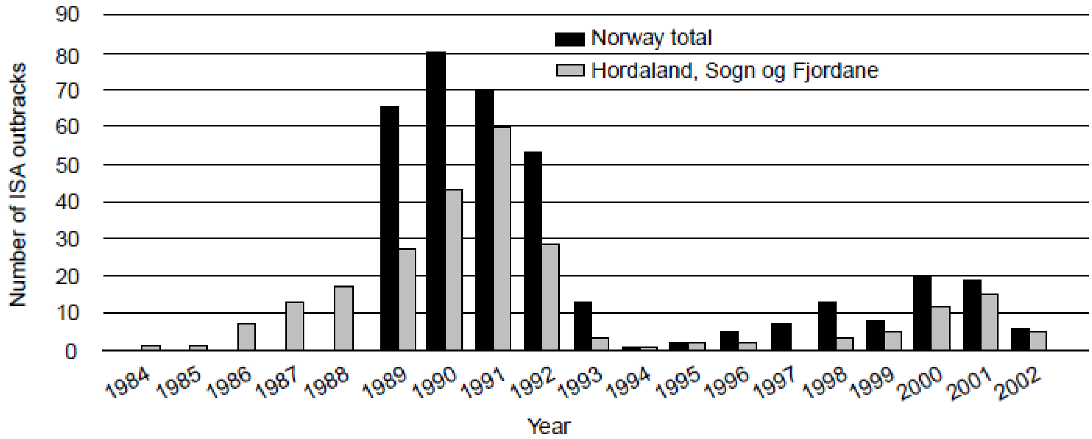


Figure 3.1: Number of sites subject to restrictions due to ISA diagnosis in Norway totally and in the counties of Hordaland and Sognog Fjordane
Source: Lyngøy (2003).

Thorud and Håstein (2003) explain that in Norway ISA spread slowly. From one cage to another, the disease spread in about one month, and in neighbouring farms in about 6-9 months. It was common to observe the first outbreak after the fish were treated with medication for other diseases. The disease exploded in 1989 and had a peak in 1990 with 80 outbreaks (as can be seen in Figure 3.1). The spread into new areas was observed after infected smolts were acquired, or in farms near slaughterhouses and processing plants. It was also observed that the explosion of the disease in 1989 occurred a year after widespread movement of cages in an attempt to escape from an algal bloom event.

Lyngøy (2003) reported that instances of ISA became notifiable events in 1988, when it was demonstrated that the disease was contagious. This allowed for regulations involving measures to control and manage outbreaks and prevent its spread. Since ISA was a new disease observed in the industry, no vaccines were available to deal with it; the knowledge to develop regulation was based on previous experiences of the transmission of infectious agents and epidemiological studies on infectious diseases in farmed fish. Reported by Vågsholm *et al*. (1994), Jarp and Karlsen (1997), and Thorud and Håstein (2003), in 1992 there was an intensive eradication campaign of the virus. However, it was clear that more scientific knowledge was needed.

Thorud and Håstein (2003) explained that the studies of Vågsholm *et al*. (1994) and Jarp and Karlsen (1997) were crucial. Through these studies it was demonstrated that the location of the farms was an important risk factor for the spread of the disease. The risk of a farm getting the virus was increased when it was located closer than 5km from an infected farm, and 5km from slaughterhouses and processing plants. The risk was lower in the vicinity of slaughterhouses that disinfected their water, but the same results were not observed for processing plants. Particular management practices were also shown to be a risk factor increasing the probability of spread. These practices included sharing staff among farms, removing deceased fish less than once a day, mixing smolts from more than one farm, and the receipt of fish previously kept in other seawater locations.

Lyngøy (2003) and Thorud and Håstein (2003) report the following measures taken by Norway to reduce outbreaks and the spread of the disease:

- proper handling and disinfection of eggs;
- disinfection of supplied seawater in hatcheries;
- the performance of at least 12 health assessments per year;
- the use of more exposed sites with better currents rather than shallow and low current sites;
- disinfection of seawater intake in smolt farms with ultraviolet light;
- daily remove of mortality and installation of silage[15] tanks;
- ensuring that production sites were 3km apart;
- restocking allowed only after the affected farm was depopulated, cleaned, disinfected and fallowed;
- prohibition of the movement of fish among sites; this was allowed for slaughter that was authorised by local authorities. In addition, when a farmer had been selected to have his fish slaughtered, hygienic procedures should be authorised for that slaughter;
- disinfection of offal and water waste from slaughterhouses and processing plants;
- the movement of fish after they were transferred to seawater was prohibited. A regulation was introduced for transport vehicles, particularly wellboats;
- disinfection of wellboats.

McGeachy and Moore (2003) stated that, in 1994 in Norway, a plan known as ‘Stop ISA-Norway 1994’ was implemented. Thorud and Håstein (2003) and Lyngøy (2003) explain that in 1996 official guidelines were introduced such as the harvest or culling of affected fish. The harvest was accelerated when the mortality exceeded 1 fish per 2,000 per day per pen. This

[15] Fish are ground into a slurry and the pH is reduced by adding acid such as formic or propionic (Carswell, Willow and Ekkert, 1990).

means that the fish of that cage should be slaughtered. If the mortality was lower than 1 fish per 2,000, the fish could continue growing and the harvest was prolonged.

According to Thorud and Håstein (2003), since it has been demonstrated that infection could be transferred into neighbouring sites, it was important to segregate the sites. Two types of zones, combat and observation zones, were defined; official guidelines introduced in 1996 were meant to be implemented in all the zones. A combat zone was established within a 5km radius from an affected location. Smolts could not be placed in sites located in combat zones. Restocking the zone was allowed after depopulation, disinfection and at least one month of fallowing. Lyngøy (2003) points out that, because of the fallowing policy, firms that did not have alternative sites had losses in Gulen and Nordfjord (Sognog Fjordane county).

Surveillance on all farms was conducted with a primary focus on sites located in combat zones. Wellboats transporting smolts could not pass closer than 20km to the affected site, and fish for slaughtering could not pass closer than 5km (Thorud and Håstein, 2003). In 1996 insurance indemnification programmes were introduced to help the farmers reduce losses due to the ISA virus (Lyngøy, 2003). The following figure shows the outbreaks of ISA in Norway between 1984 and 2002, and the measures adopted over time.

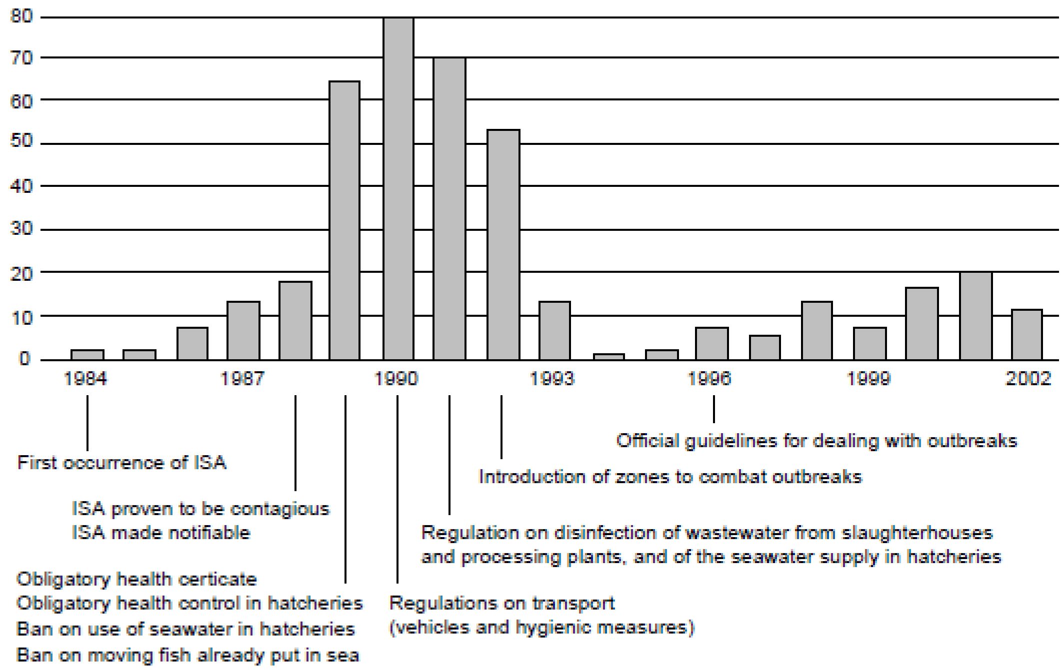


Figure 3.2: Outbreaks of ISA in Norway 1984-2002 and adopted measures
Source: Thorud and Håstein (2003).

It can be seen from the figure that between 2000 and 2002, there was a new period of outbreaks, but not as severe as those observed in 1989-1992. This re-emergence demonstrated that the measures adopted were not sufficient to permanently eradicate the disease. Thorud and Håstein (2003) point out that it is suspected that the outbreaks in the 2000s were related to the transport of smolts and fish to slaughterhouses, and/or the use of vaccines against other diseases that allowed the spread of ISA through infected fish that were not detected. Reported by Thorud and Håstein (2003) and Lyngøy (2003), in the 2000s the government and industry agreed to replace the regulation with a contingency plan, which was implemented in 2003. The aim of this plan was to reduce the risk of the disease spreading. According to Cipriano and Miller (2003) the annual cost of ISA outbreaks in Norway was US$ 11 million.

Canada

The following account is based on McGeachy and Moore (2003), who reported the Canadian experience of ISA in New Brunswick in 1996, the first time that ISA was reported outside Norway. The Canadian industry established 22 Bay Management Areas (BMAs) within the south-western part of the Bay of Fundy. This organisation was made to facilitate single year class[16] farming and agreements of code of practice.

In the summer of 1996, two sites, Lime Kiln Bay and Bliss Harbour, located in two different BMAs, experienced high levels of unexplained mortality in Atlantic salmon of the 1995 year class. Disease investigations were concentrated on bacterial assays before viral, toxicological and histological ones. Other farms in these two bays also started to experience sustained levels of mortality. In late 1996 lesions in the kidneys and livers of fish were identified, and it was possible to describe a distribution on the mortality events. The lesions observed in the fish were not consistent with other known disease agents, and therefore the observed condition was termed as Hemorrhagic Kidney Syndrome (HKS). Some researchers thought that this condition was a new clinical presentation of Bacterial Kidney Disease (BKD)[17] because a number of farms with HKS had BKD. Antibiotics were used to treat the fish but this did not reduce the HKS.

[16] 'The group of young of one kind of animal produced during one year — used chiefly of fishes' (http://www.merriam-webster.com/dictionary/year%20class Last accessed: 13 February 2013).

[17] 'A disease of trout and salmon caused by the bacterium Renibacterium salmoninarum. The disease is systemic but derives its name from off-white bacterial lesions in the kidney. In later stages many organs may become affected and the body cavity may become filled with fluid' (http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10950-27345--,00.html Last accessed: 28 May 2013).

In September 1997 the Research and Productivity Council isolated and identified ISAv, which was demonstrated to be the causative agent for HKS. The National Veterinary Institute in Norway confirmed this finding. Based on the Norwegian experience and the risk factors identified at that time, New Brunswick implemented control and management strategies to deal with ISA. Different complementary programmes were implemented. They included:

- an Integrated Management Plan based on detection, containment, control and prevention. It was based on the programme Stop ISA-Norway 1994 and the revision of risk factors;
- an Eradication Programme based on the depopulation of clinically infected fish placed by a Ministerial order;
- an ISA Management and Control Programme by the industry and New Brunswick Department of Fisheries and Aquaculture. This programme considered husbandry, harvesting, processing and transport practices, as well as disinfection of equipment, replacement of wooden cages, wooden harvest barges and wooden feed boats. This programme was based on the Norwegian experience and advised by the Fish Technical Committee. It involved:
    - an ISAv Surveillance Programme with the aim of detecting subclinical outbreaks of ISA in cages and sites at the earliest opportunity, and to detecting early clinical outbreaks in cages;
    - ISAv tests were performed at the New Brunswick Department of Fisheries and Aquaculture on weak and moribund fish;
    - the restructuring of the industry on a single year class;
    - a Compensation Programme for stock depopulation by the Canadian government. The government and the Province of New Brunswick funded a compensation programme for a period of three years. In 1999 it was mandatory by regulation for farmers to secure self-compensation. In 2003 an indemnification for ISA and other exotic diseases was proposed;
    - disinfection of materials and equipment;
    - the control of vectors such as sea lice;
    - research on ISAv, particularly on the identification of strains, virus transmission from broodfish, methods of virus detection and epidemiology;
    - the treatment of blood, water and waste in processing plants;
- a Market Protection Programme by the industry. Human health and consumer perceptions were addressed by a comprehensive plan developed by a public relations firm hired specifically for that purpose;

Some measures adopted by the Canadian industry were:

- the depopulation (removal of salmon from the water; emptying a site) of infected stock, followed by fallowing of those areas for 10 to 12 months before restocking;
- disinfection and harvesting procedures;
- implementation of zones or areas of concern in which there was some degree of early mandatory harvesting of marketable fish, and smolt placement restrictions by Ministerial orders;
- the implementation of a fallowing period of four months for many affected BMAs, however, at that time there was no scientific data on the minimum effective fallow period.

In 1998 a Fish Health Technical Committee was established, composed of industry veterinarians and government representatives. This committee was in charge of fish health issues in the Bay of Fundy and of advising the New Brunswick Minister of Fisheries and Aquaculture. The depopulation of total sites was not considered as an option, however, the industry and government agreed on the elimination of infected salmon, cage by cage, in order to reduce the spread of the virus within and between sites.

By the end of 1999, approximately 58% (50 out of 86) of the farms in New Brunswick were affected by ISA and the virus continued to spread slowly. During the period 1997-2002, 55% of the farms in New Brunswick were affected by ISA. According to Cipriano and Miller (2003), the annual cost of ISA outbreaks in Canada was US$ 14 million.

<u>United Kingdom (Scotland)</u>

Stagg (2003) reported that the first outbreak of ISAv reported in Scotland was in Loch Nevis in May 1998. From there the virus spread to 11 farms that were confirmed (i.e. farms showing clinical signs of the disease) and 25 farms that were suspected (i.e. farms with evidence of infection but inconclusive results to prove clinical disease) of containing the virus. The peak of confirmed cases was in June 1998. The characteristics of the site where the first outbreak was detected, and therefore the conditions that allowed the emergence of the virus, were high densities, multiple fish movement in seawater, multiple generations of fish used in continuous stocking.

Stagg (2003) pointed out that the origins of the virus in Scotland are unknown. It could have been transferred from Norway by contaminated wellboats, or emerged from a wild fish benign infection. According to Stagg (2003), since the first outbreak of the virus, the industry and government worked together in a working group and developed a code of practice to prevent new ISA outbreaks and the spread of the disease. This code involved the movement of fish and equipment, the management of areas using a tidal excursion model, and practices for harvesting, processing and waste disposal. The code also provided guidance for fallowing and the adoption of a single year class.

Scotland was the first country within the European Union to present ISA (Norway is not part of the European Union). In 1991, ISA was listed as an exotic disease in List I for the European Union. Therefore the management of the disease, including contingency plans, should have been based on surveillance to identify the disease at the earliest opportunity, the application of biosecurity measures to prevent spread, and the elimination of sources of infection via an immediate depopulation programme. This programme involved the removal of fish from affected farms, thus managing the risk of spreading the disease in processing and disposal. Depopulation of affected farms was required, but this decision was made according to the available logistic facilities. The farm was allowed to harvest and/or sell the fish if they did not show signs of the disease, otherwise the fish were culled and ensiling in formic acid to inactivate the virus.

Based on the Norwegian experience, flexible depopulation of individual cages on affected farms was discussed. The depopulation in phases and the use of vaccines was allowed. Doing this, it was possible to ensure a rapid depopulation over 21 days, which was an important factor in eradicating the disease compared to other countries that waited for harvesting (McVicar, 2003; Stagg, 2003).

ISA in the European Union is covered by two European Commission Directives: one related to trade in aquaculture products since 1991, and other related to control of fish diseases since 1993 (Stagg, 2003). These Directives were incorporated into the United Kingdom through the 1992 Fish Health Regulations, 1994 Diseases of Fish Control Regulations, and 1997 Fish Health Regulations (McVicar, 2003), although ISA has been a notifiable disease to the Official Service since 1991 under the Diseases of Fish Acts 1937, 1983 (McVicar, 2003; Stagg, 2003). This means that at the time of the first outbreak of ISAv in Scotland in 1998, the United Kingdom already had a specific regulation for fish diseases and some measures to deal with ISA. Thus, immediate measures could be implemented to control the disease.

McVicar (2003) and Stagg (2003) explain that the UK Diseases of Fish Acts 1937, 1983 were, in principle, developed to deal with furunculosis[18] in wild salmon in Britain. However, it proved to be highly flexible and adaptable for other diseases in fish farming, such as ISA. They allowed changes to deal with ISA when it was seen that aspects of the European Union regulations were impractical. In this way, the existing UK legislation needed to be adjusted in order to define zonification (i.e. define affected zones) and fallowing periods.

When the determination of the affected coastal zones (i.e. zonification) was required, there was no hydrographic data easily available and there was little information about the passive transmission of the virus. With basic information available about horizontal transmission and generic information on tide currents, a model was developed based on the distance of confirmed or suspected farms and their risk to other farms. This model was established to define control and surveillance zones.

On the other hand, since some farms had a high number of fish by 2000, the regulation was amended to put it in a more practical way and, in accordance with the Competent Sanitary Authority, a schedule for fish depopulation was established. Complementary to this, Scotland was advised by Norwegian and Canadian regulators, but with some precautions since there were some differences among those industries, such as the hydrography, ecosystems and farming practices. Given these differences, a different spread and effects of ISA could be expected in Scotland compared to other countries.

Since some regulations already existed, the Competent Sanitary Authority already had the powers to ensure the successful management of outbreaks and it was possible to implement control measures immediately. The powers of the authority involved the establishment of requirements for notification of confirmed or suspected cases in any specie, the introduction of measures in affected areas including surveillance zones with depopulation of affected sites, the provision to investigate the origins of the outbreaks and their risks to the transfer of fish, and the provision for fallowing sites before being restocked.

Early warning was critical in managing the disease. Therefore, the regulation stated that evidence of the disease, or suspicions of it, should be notified to the official authority without

[18] 'A bacterial disease of salmonids that is usually characterized by boils or furuncles on the skin of affected fish although this is not always the case. The causative agent is the bacterium Aeromonas salmonicida. Furunculosis is systemic in nature as it travels through the bloodstream and affects all parts of the body, especially the vital organs. The rapid multiplication of bacteria in the bloodstream causes smaller blood vessels to rupture allowing the bacteria to spread to surrounding tissue. When allowed to advance to this stage, the disease is always fatal' (http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10950-27389--,00.html Last accessed: 28 May 2013).

delay. An important aspect of the regulation was to cover all susceptible fish species. Thus, immediate measures were applied to affected farms, suspected farms and farms sharing coastal water with confirmed and suspected farms. These measures involved the prevention of fish movement, equipment, personnel, boats and dead fish, the fallowing and disinfection of farms, and the immediate depopulation of confirmed farms (fish could be either harvested for sale if that was possible or destroyed).

Stagg (2003) states that the establishment of fallowing periods was based on the Norwegian experience, and McVicar (2003) points out that six months was the fallowing period required by the Competent Sanitary Authority for confirmed farms. However, different fallowing periods were established in suspected farms and where there was no evidence of infection, as well as in control and surveillance zones. Thus, according to Stagg (2003), the fallowing periods were between three and six months, and they were determined by a risk assessment. The criteria for this risk assessment were the geography and hydrography of farm sites, the evidence of infection transmission to wild fish, the density of farms, and the common use of facilities. McVicar (2003) points out that the risk assessment was the base of the development of the measures in Scotland. Each outbreak was re-evaluated via risk assessment.

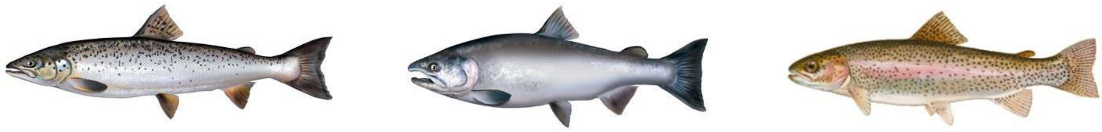
As reported by Stagg (2003), cages, nets, and all structures and equipment that were in contact with infected fish were required to be cleaned and disinfected; nets were required to be transported to specific sites for cleaning with the possibility of leaking being prevented. McVicar (2003) states that in 2001 the possibility for indemnification or compensation for depopulated stocks was introduced, but at the time of the outbreak in 1998 it was not possible to do this in either the European Union or United Kingdom. According to Cipriano and Miller (2003), the costs of the 1998-1999 ISA epidemics in Scotland was valued at US$ 32 million (Cipriano and Miller, 2003).

3.3. Infectious salmon anaemia in Chile and the sanitary crisis of the salmon farming industry

As seen in the previous section, infectious salmon anaemia is a viral disease of marine-farmed Atlantic salmon. However, there are other species distinct from Atlantic salmon, such as Coho salmon and rainbow trout, that, although they do not develop the disease, may act as carriers, vectors and reservoirs causing negative biological externalities such as the dissemination of ISAv.

Chile mainly produces and exports three different types of salmon species: Atlantic salmon, Coho salmon and rainbow trout. Figure 3.3 provides a picture of the main physical features of these species and their productive cycle. They are all exotic species to Chile[19] and were introduced for sport and commercial purposes[20].

Atlantic salmon (Salmo salar)	Coho salmon (Oncorhynchus kisutch)	Rainbow trout (Oncorhynchus mykiss)



The average length of an Atlantic salmon is 45 cm and 7 kg in weight. Its colour is brown, green or blue on the back, its flanks silvery and its belly is silvery white (SalmonChile website). Its production cycle is 8-16 months for the freshwater phase, and up to 24 months for the seawater ongrowing phase (FAO 2004-2012).	The average length of a Coho salmon is 45 cm and its average marketed weight is 5 kg. Its colour is brown, green or blue on the back, it has silvery sides and its belly is silvery white (SalmonChile website). Its production cycle is 8-12 months for the freshwater phase, and 10-12 months for the seawater ongrowing phase (FAO 2006-2012).	The average length of rainbow trout is 30-40 cm and its marketed average weight is 3 kg. Coloration blue to olive green above a pink band along the lateral line and silver below. Back, sides, head and fins covered with small black spots. Colouration varies with habitat, size, and sexual condition (FAO 2005-2012). Its production cycle is performed on the land for the freshwater phase and in coastal marine environments for the ongrowing phase. The ongrowing phase is nine months approx. to reach marketable size (FAO 2005-2012).

Figure 3.3: Salmon species produced in Chile
Source: SalmonChile (2014), FAO (2004-2012), FAO (2006-2012) and FAO (2005-2012).

From experimental production, Chile has become the second largest producer and exporter of salmon in the world after Norway. This achievement has been possible by the intensive exploitation of the natural common-pool resource water, which has inevitably caused negative ecological externalities. For Atlantic salmon from a production of 41 tonnes in 1987, by 2000 Chile became the second largest global producer after Norway with 166,897 tonnes. Chilean Atlantic salmon production peaked in 2008 with 388,847 tonnes. For Coho salmon from a

[19] Atlantic salmon naturally inhabits in the North Atlantic Ocean and adjacent waters, including the Great Lakes in the United States and Canada. Coho salmon is a native species of the northern Pacific coast. Rainbow trout is native to the Pacific drainages of North America ranging from Alaska to Mexico (Knapp, Roheim and Anderson, 2007; FAO, 2004-2012; FAO, 2005-2012; FAO, 2006-2012).

[20] Atlantic salmon and rainbow trout were introduced to the country from Germany in 1935 and 1905 respectively for recreational angling, whilst Coho salmon was introduced from the United States in 1970 onwards for aquaculture purposes (FAO, 2005-2012).

production of 49 tonnes in 1978, Chile became the largest global producer in 1993 with 25,150 tonnes, followed by Japan. Chilean Coho salmon production peaked in 2009 with 156,960 tonnes. For rainbow trout, from a production of less than 0.5 tonnes in 1970, Chile became the largest global producer in 1996 with 54,429 tonnes. Chilean rainbow trout production peaked in 2010 with 220,244 tonnes (FAOSTAT). The following figure shows the production of these species over time.

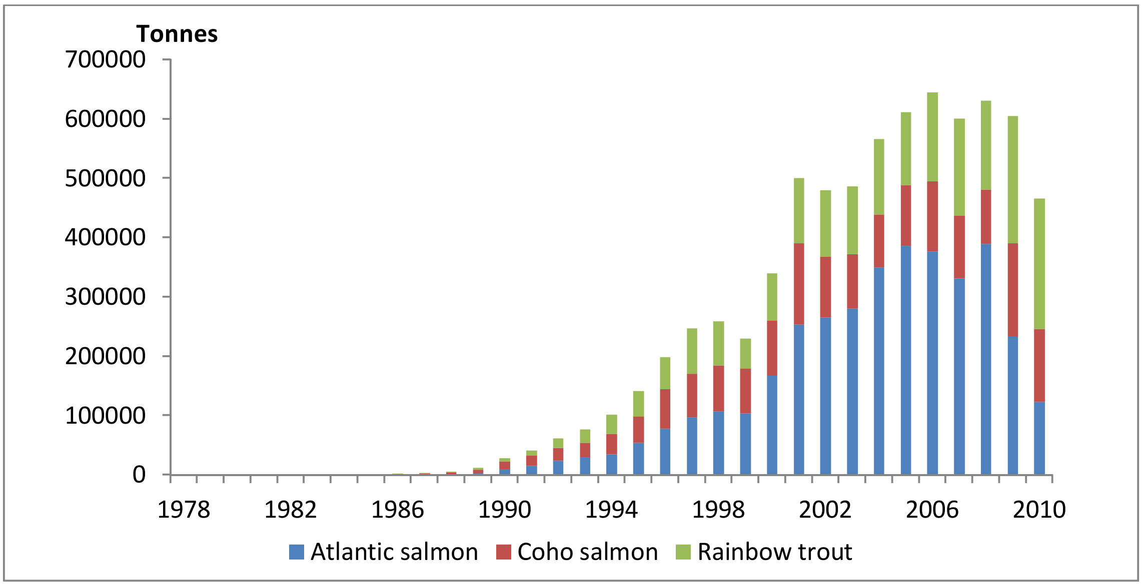


Figure 3.4: Production of main Chilean salmon species over time
Source: Own elaboration based on FAOSTAT.

In Chile, and in the southern hemisphere, the first detection of ISAv goes back to 1999 when the virus was found in marine-farmed Coho salmon. It was demonstrated that it belonged to the North American genotype similar to the Canadian ISAv. Even when ISAv was isolated from clinically sick Coho salmon it was observed that the presentation of the clinical disease was different from that observed in Atlantic salmon (the natural specie for the virus). ISAv in Coho salmon has only been associated with a clinical condition called Icterus Syndrome[21]. The origins of ISAv in Coho salmon in Chile are unknown (Kibenge *et al*., 2001; Godoy *et al*., 2008).

However, the ISAv that caused the sanitary crisis in the Chilean salmon farming industry was found in 2007 in farmed Atlantic salmon. The ISA sanitary crisis in Chile as an industry natural resource crisis was an event, natural or man-made, sudden or progressive, which impacted the hygienic conditions of the salmon industry attempting against health and facilitating the

[21] 'The presence of jaundice seen in the sclera of the eye. Yellowing of the skin and the whites of the eyes caused by an accumulation of bile pigment (bilirubin) in the blood; can be a symptom of gallstones or liver infection or anaemia' (http://www.biology-online.org/dictionary/Icterus Last accessed: 28 May 2013).

development and spread of the infectious salmon anaemia with such severity that industry and government had to respond by taking exceptional measures.

In farmed Atlantic salmon the first report of ISAv in its typical presentation appeared in mid-June 2007 in two cages in a grow-out site owned by Marine Harvest (the largest salmon firm located in Chile at that time) located in Lemuy Island (Central Chiloé – Region X. Figure 3.5 shows this location). This is considered as the index case[22] of the sanitary crisis in the Chilean industry, although the Fisheries Service (Sernapesca for its Spanish acronym) states that on 25 July 2007 the industry reported positive signals of the disease (Sernapesca, 2012). Those fish were recovering from an outbreak of Piscirickettsiosis[23] and treated several times for Rickettsia using antibiotics that prevented death from Piscirickettsiosis. The fish were removed after four weeks and the cumulative mortality in those cages was between 70% and 82%.

There was a high mortality attributed to amoebas[24] and flexibacteriosis[25] in other farming centres in the same area, which added confusion to the diagnosis. Since the firm decided to harvest all the remaining cages in advance, independent of the clinical status of the fish, the mortality of the farm was just 13%. It cannot be said that the Piscirickettsiosis contributed to the pathologic findings observed as ISA (Godoy *et al*., 2008; Sernapesca, 2008b; La Tercera.com, 2009).

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[22] 'It refers to the first disease case in an epidemic within a population' (http://science.education.nih.gov/supplements/nih1/diseases/other/glossary/act1-gloss3.htm Last accessed: 5 January 2013).

[23] 'Piscirickettsiosis is a disease of salmonids caused by Piscirickettsia salmonis that was first reported in farmed Coho salmon (Oncorhynchus kisutch). The disease was initially described in 1989 from fish in Chile' (http://www.cefas.defra.gov.uk/idaad/disease.aspx?id=4 Last accessed: 28 May 2013).

[24] 'Genus of protozoa, but also an imprecise name given to several types of free living unicellular phagocytic organism' (http://www.biology-online.org/dictionary/Amoebas Last accessed: 28 May 2013).

[25] 'The causal agent of flexibacteriosis is generally thought to be a Flexibacter sp. This group is comprised of several genera. They are usually chromogenic, filamentous bacteria that can cause disease conditions as diverse as columnaris, fin rot, coldwater disease and gill disease' (http://www.cefas.defra.gov.uk/idaad/disease.aspx?id=12 Last accessed: 28 May 2013).

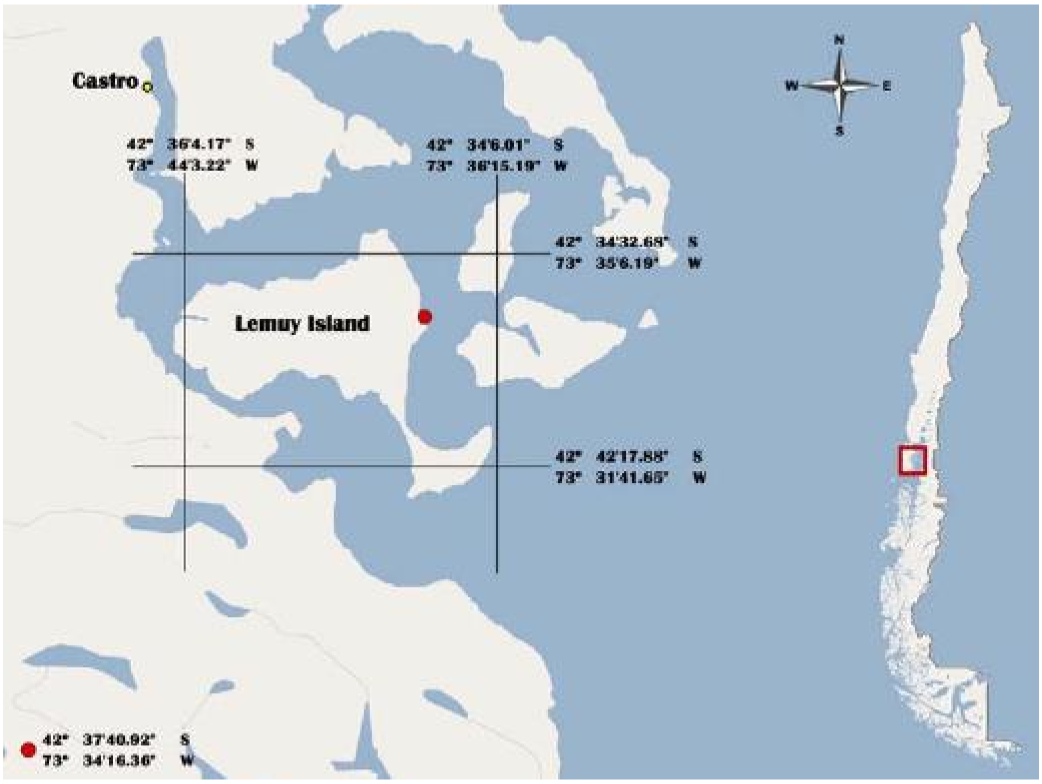

Figure 3.5: Geographical location of the index case
Source: Godoy *et al*. (2008).

There are studies that conclude, and information that suggests, that ISAv was present in Chile prior to the appearance of the index case in 2007. As mentioned previously, according to the studies of Kibenge *et al*. (2001) and Godoy *et al*. (2008), ISA was detected in the country in Coho salmon in 1999, although not in its classical presentation.

The study conducted by Kibenge *et al*. (2009) identified that the Chilean ISAv had seven distinct strains and they belong to the European genotype. Using a phylogenetic analysis the similarity between the Chilean isolates and the Norwegian isolates reported in 1996 was noted, and around 2005 (two years before the index case) the virus was quickly disseminated in the Chilean Atlantic salmon industry. Godoy *et al*. (2008) specify that the Chilean ISAv was a different variant from common European and North American genotype ISAv isolates[26].

ISAv of the North American genotype was detected in Lake Llanquihue between 2001 and 2003. Lake Llanquihue is not the same place in which the index case appeared in 2007. It is not known why this ISAv did not produce outbreaks in the Chilean industry at that time like those

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[26] 'The Chilean ISAV responsible for the ISA outbreak in Chile in 2007 is unique in that it has a 33-nucleotide (or 11-amino acid) insert in the middle of RNA segment 5 which encodes the F glycoprotein' (Godoy *et al*., 2008, p.9).

in Canada and United States, or why the virus was not spread in the Atlantic salmon industry in Chile (Godoy *et al*., 2008).

Vike, Nylund and Nylund (2009) conclude in their study that the ISAv they isolated in 2008 in Chile must have been transmitted to Chile from Norway through infected Atlantic salmon eggs in the previous 10 years. The conclusion of this vertical or trans-generational transmission is based on the following factors:

i) the Chilean ISAv isolates group with contemporary Norwegian ISAv genotypes;
ii) there is a large export of eggs from Norway to Chile;
iii) all salmonid species were introduced in Chile and therefore there is no possibility for natural reservoirs in Chile; and
iv) there are other studies that document the vertical transmission of ISA virus, for example, the study of Nylund *et al*. (2007) in which it is suggested that, in the Norwegian industry, vertical transmission played a major role in spreading the virus.

Vike, Nylund and Nylund (2009) point out that this result shows a need for restructuring the production of Atlantic salmon in Chile and reduce the introduction of exotic diseases into the country. There is a need for having better control of the import of eggs or the reduction of import of embryos from those places with a natural population of salmon, and then the risk of importing diseases is reduced. Another measure suggested by the authors for the Chilean and Norwegian industries is to produce brood stock in a controlled environment free from ISAv. This can avoid the circulation of the pathogen in the production cycle by screening brood stock for ISAv. It will be seen later that both the import of eggs and the production of brood stock in a controlled environment were controversial topics in the Chilean salmon industry. The vertical transmission proposed by Vike, Nylund and Nylund (2009) is shared by Godoy *et al*. (2008) who state that the Chilean ISAv from Atlantic salmon in 2007 differs from the Chilean ISAv from Coho salmon in 1999, and therefore it is unlikely that the virus from 1999 was the source of the virus in 2007. Both viruses (1999 and 2007) differ in their RNA.

Alvial *et al*. (2012) report that some laboratories detected ISAv in Atlantic salmon in Chile prior to 2007, however, these detections were not reported because they could not be confirmed. Also they state that around 2004 there was an increase in fish mortality for non-identified causes, particularly in areas with a large number of farms.

The following figure shows the monthly mortality by specie for the period 1998-2011.

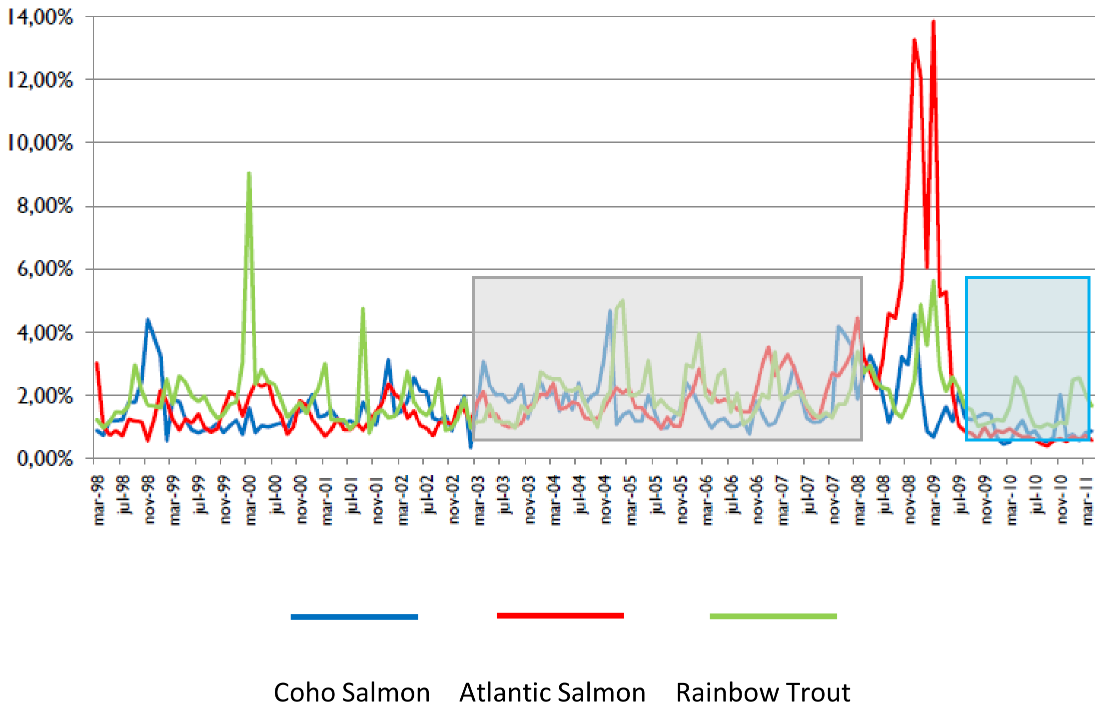


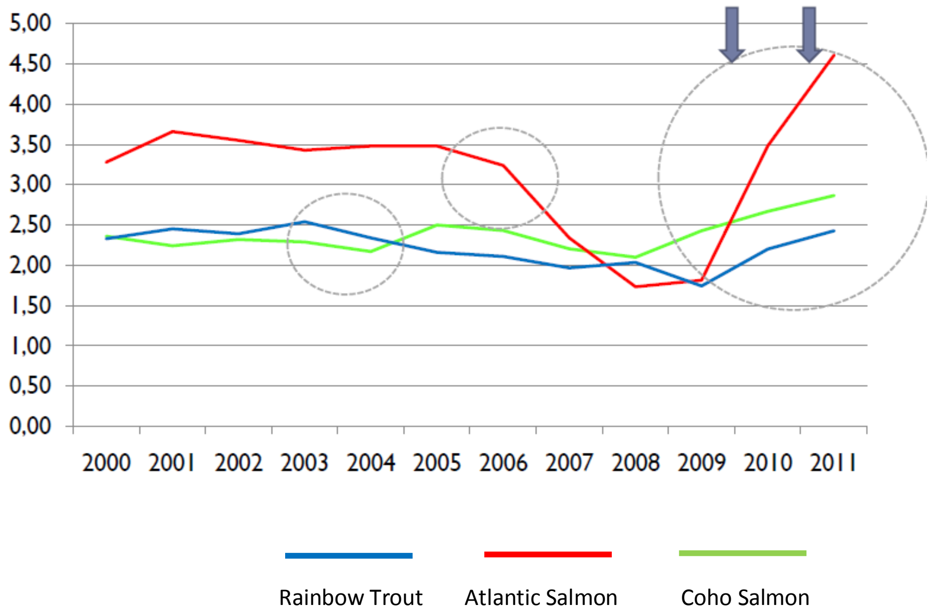
Figure 3.6: Monthly mortality by specie for the period 1998-2011

Source: Garate (2011).

In an interview to the press, the Managing Director of Marine Harvest Chile at that time[27], pointed out that, since 2004, the industry had shown a decrease in productivity caused by fish diseases that started to kill fish. To deal with diseases and lower productivity results, the industry used a larger amount of antibiotics and smolt. As a consequence, there was an increase in fish densities per area. He affirms that the identification of the index case in a farming centre owned by Marine Harvest did not mean that the virus started in that farm. He asserted that the firm was able to detect the virus because it had the mechanisms and experience to do so; also, since the firm produced 25% of the total local production at that time, there was a high probability of detecting the virus there (La Tercera.com, 2009).

The following figures show the productivity of the Chilean industry between 2000 and 2011, and the productivity of Chilean and Norwegian industries, respectively.

[27] Álvaro Jiménez was the Managing Director of Marine Harvest Chile between April 2008 and January 2011 (http://www.marineharvest.com/en/Investor1/Press-releases/2011/Appointment-of-new-Managing-Director-in-Marine-Harvest-Chile/ Last Accessed: 6 January 2013).



Figures 3.7: Productivity (kg harvested/smolt entered) of Chilean industry between 2000-2011

Source: Garate (2011).

A decrease in the productivity of Coho salmon and rainbow trout in 2003-2004 and of Atlantic salmon between 2006 and 2009 has been observed.

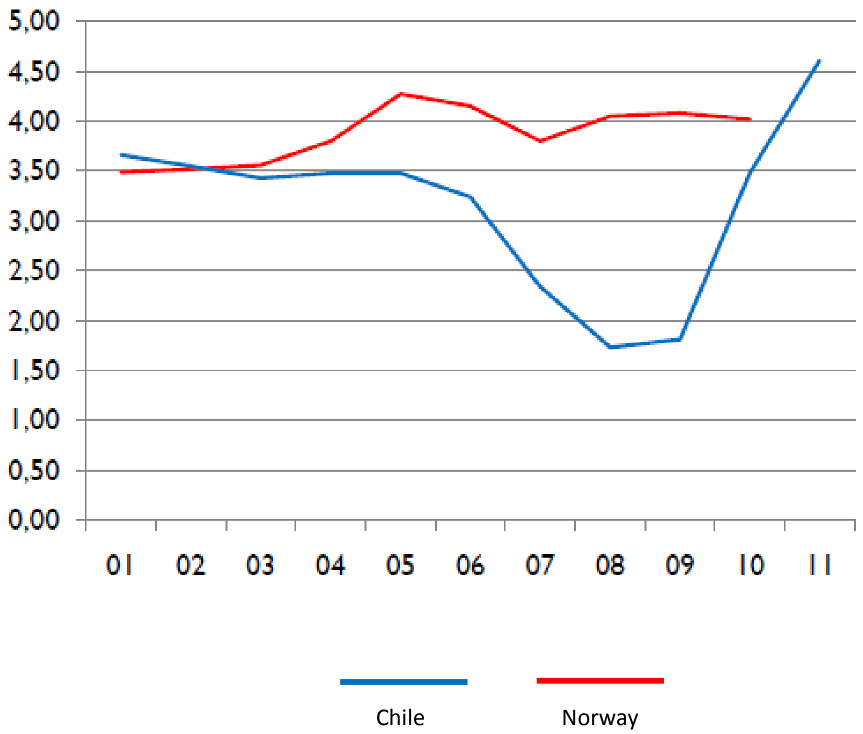


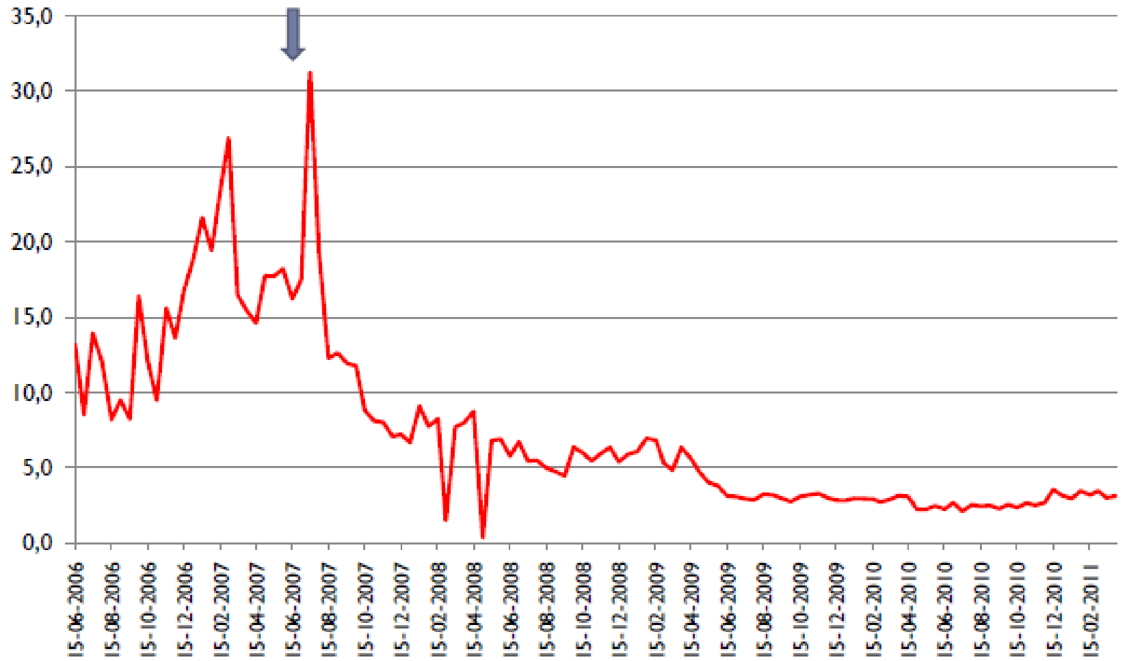
Figure 3.8: Productivity (kg harvested/smolt entered) Chile versus Norway between 2001-2011

Source: Garate (2011).

The above figure shows that since 2003 the productivity of the Chilean industry was lower than the Norwegian industry, with noticeable difference since 2004. The lowest productivity of the Chilean industry was in 2008. The decrease in productivity of the Chilean industry suggests, on the one hand, that the sanitary crisis of the industry was partially a man-made event. This is because the mortality of fish and its effects were inadequately managed through an increased use of antibiotics and fish density, which led the industry to exploit natural resource water more intensively. On the other hand, it suggests that, although the first outbreak of ISAv suddenly appeared in 2007, the conditions to reproduce the virus were progressively developed over a long time. In this way the decrease in productivity and the emergence of ISAv can be considered as implications of a production-intensive model.

A large number of individuals interviewed during fieldwork (e.g. from producer firms, bureaucrats, NGOs and Associations) mentioned that before the index case, the industry was showing a high level of Caligus. It has been said that this louse acts as a vector of ISAv, which suggests the virus could have been present and progressively developed prior to its report in 2007. Like ISAv, the caligus affects the Atlantic salmon, Coho salmon and trout differently. The susceptible species for caligus are Atlantic salmon and rainbow trout. Certainly the presence of caligus in the industry was a negative biological externality (a concept discussed by Tullock, 1971) to disseminate the ISAv across the industry.

The following figure shows the evolution of caligus for the Chilean industry. A steady increase in caligus levels since 2006 with a peak in July 2007 (few weeks later than the index case) can be seen.



y-axis: number of caligus per fish

Figure 3.9: Evolution of Caligus for all the species period 2006-2011
Source: Garate (2011).

Since the appearance of the index case in June 2007 other grow-out centres started to test positive for ISA and the number of farming centres peaked in August 2008. As Figure 3.10 shows, at the end of 2007 the accumulated outbreaks reached 10 and by the end of 2008 there were 108 outbreaks detected in farms.

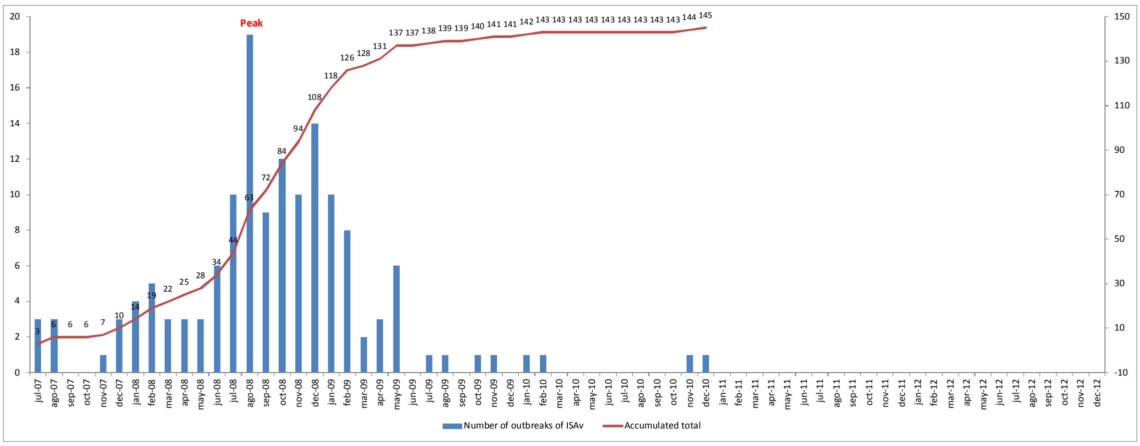


Figure 3.10: Number of outbreaks of ISAv for 2007-2012
Source: Own elaboration based on Sernapesca (2008b) and Sernapesca (2013)

Several interviewees, such as some producer firms, a representative from the media and a consultant, reported during fieldwork that, at the beginning the report, the virus was ignored as a signal of a serious sanitary problem affecting the entire industry because it was believed to be an isolated case of ISAv at just one firm. An interviewed producer firm states that there was also a lot of ignorance in diagnosing the disease, whilst several individuals pointed out that the information about the existence of the disease was concealed by the industry for several months. An interviewed NGO was more specific on this point, saying that the employees were actually the ones that denounced to the authorities the unusual fish mortality, in amount and unknown reasons, reported an epidemic and the urgency of firms for early harvesting. Yet, it was concluded that this situation was obeyed by the ISA, and policy makers publicly denounced the situation that generated the alarm.

Adolfo Alvial, who was the Technical Director at Marine Harvest Chile in 2007, reported the first confirmed case of ISAv in Atlantic salmon to the authorities (Aqua.cl, 2010b). He pointed out that, when veterinarians in the firm informed him of the suspicion of ISAv, the firm immediately took action to confirm it with international laboratories. Laboratory confirmation was made using PCR and cell culture. He said that it would have been irresponsible to give this information without confirmation, that the confirmation of the disease abroad took a couple of weeks, and when the firm got the results it arranged a meeting with the Association of Salmon Industry (SalmonChile) and sanitary authority (Sernapesca) on the same day to inform them about it. Alvial points out that Marine Harvest Chile alerted SalmonChile about the sanitary crisis, and that it could not be believed that the virus would exist just in one cage in one firm given its nature. In that meeting it was said by the firm that ‘the only thing we can do in the light of the international experience is to see if we –as an industry–can survive eliminating the cages that present the signals of the disease...there, we made a mistake as a country...we should have eliminated the entire farming centre, that one, and the next one and the next one...’ (Adolfo Alvial Interview, 18 May 2011).

After the index case, new outbreaks were detected in a short period of time in farming centres owned by firms other than Marine Harvest (the first one reporting the virus to Sernapesca), demonstrating that the first report of ISAv was not an isolated case of just one firm but an industry problem. As is a feature of viruses, ISAv rapidly spread across firms and Regions X and XI.

An interviewed producer firm pointed out that, apart from industry practices, natural conditions helped in the dissemination of the disease, such as the geography of the country that does not allow natural barriers (unlike Norway whose geography forms a natural barrier between fjords), and the currents.

In 2007 the Infectious Salmon Anaemia was an exotic disease in the country, and private and public veterinaries were inexperienced in detecting the clinical presentation of the disease in a timely manner (Sernapesca, 2010b). At the beginning, the dismissal of the virus as a serious sanitary industry problem, the ignorance in diagnosing the disease, and the time used to get international confirmation of the disease, resulted in several months delay in the development and implementation of measures to face the virus.

Between July 2007-July 2008, 18 firms had farming centres with outbreak(s) of ISAv. As it is not difficult to think, the majority of these centres (38.6%) were owned by Marine Harvest as shown in Table 3.1.

Table 3.1: Outbreaks for firms and regions July 2007-2008

Firm	Outbreaks			
	Region X	Region XI	Total	%
Marine Harvest	17	0	17	38.6%
Aguas Claras	1	0	1	2.3%
AquaChile	1	0	1	2.3%
Cultivos Marinos Chiloé	3	0	3	6.8%
Invertec	2	0	2	4.5%
Mainstream	5	1	6	13.6%
El Golfo	0	1	1	2.3%
Multiexport	2	1	3	6.8%
Pacific Star	4	0	4	9.1%
Salmones Humboldt	1	0	1	2.3%
Camanchaca	1	0	1	2.3%
Holding & Trading	0	0	0	0.0%
Congelados del Pacífico	2	0	2	4.5%
Salmones Maullín	0	0	0	0.0%
Fiordo Blanco	1	0	1	2.3%
Granja Marina Tornagaleones	0	0	0	0.0%
Salmones Friosur	0	0	0	0.0%
Salmones Antártica	1	0	1	2.3%
Total	41	3	44	100.0%

Source: Sernapesca (2008b).

Out of 44 outbreaks of the disease, 41 (93.1%) occurred in Region X, whilst the remaining outbreaks (3) occurred in Region XI. The farming centres showing positive for ISAv in the XI Region were not owned by Marine Harvest, as Table 3.1 shows. No ISAv outbreaks in farming centres were present in XII Region during 2007 and 2008. Figure 3.11 shows the monthly outbreaks for Regions X and XI.

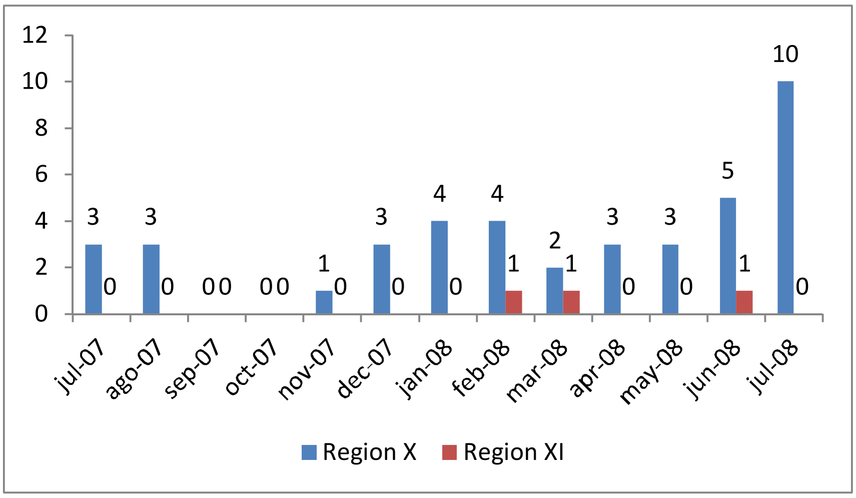


Figure 3.11: Monthly outbreaks per region July 2007-July 2008
Source: Own elaboration based on Sernapesca (2008b).

A generally shared view across interviewed actors was that the most prominent signal that a sanitary crisis (as opposed to an isolated sanitary problem) was occurring, was the high levels of salmon mortality in the industry that were occurring in different farms that belonged to different firms. This signal contributed to transform the first ISAv outbreak into an industry problem. The confirmation of ISAv in Chile from international laboratories also helped to persuade the industry that the isolated first outbreak was an industry problem, because at that moment the industry was already aware of the experiences of other salmon-exporter countries -such as Norway and Canada, which had experienced an ISA crisis in the past '(see the previous section).

When ISAv was confirmed in Chile, ISA outbreaks became a priority issue in the government decision-making agenda, and it was understood that additional specific measures were needed to control the virus and solve this sanitary crisis. Vaccines were not available in the country at the time of the crisis, nor did the sanitary, environmental or other regulations include specific measures to deal with ISAv (outbreaks and spread). This triggered policy responses as will be seen in the next chapter.

Chile was the last of the global salmon producers and exporters to experience ISA, a virus and disease that was not new worldwide as there had already been more than 20 years history of its existence. However, there are three main differences between the sanitary crisis in Chile and the sanitary crises experienced by other global salmon producers such as Norway, Canada, the United Kingdom and the United States. The first two following points were widely mentioned by interviewees during fieldwork. The last point was concluded after the review of literature on ISAv.

At the time of the sanitary crisis in Chile, the Chilean industry was considerably larger in size compared to other global salmon producers when they experienced the crisis. For example, the scale of production of Atlantic salmon in Chile was about 15 times larger than Norwegian production, and about 9 times larger than Canada's production. Because of this, the economic loss to the Chilean industry was greater than the other global producers. The following figure shows the Atlantic salmon production in countries that experienced ISA showing output (in metric tons) of the countries according to year when their respective industries suffered from the crisis (hence the observation for Chile is much larger).

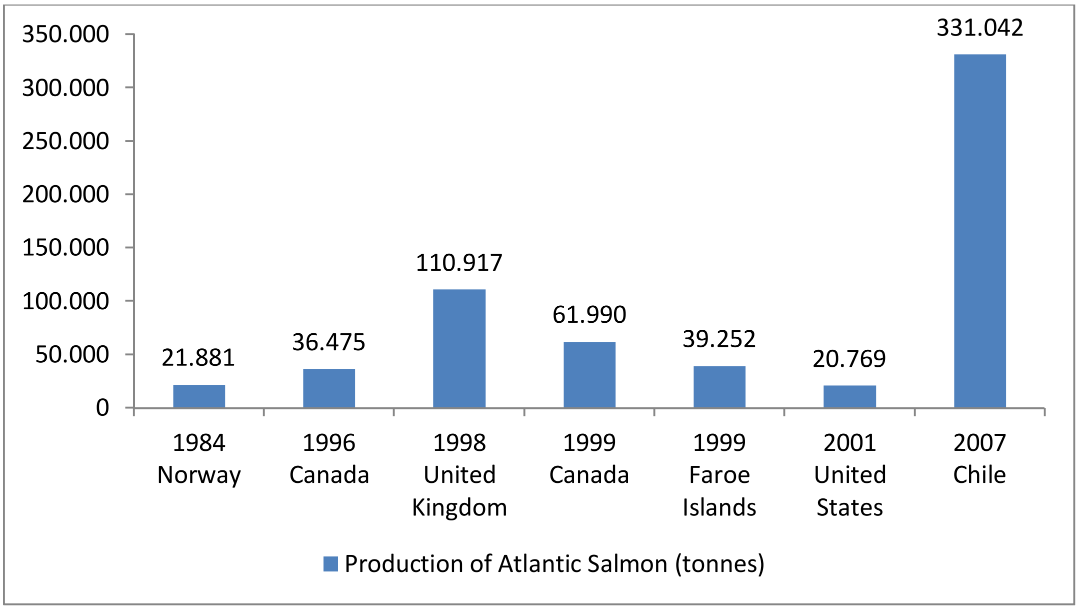


Figure 3.12: Atlantic salmon production of countries experiencing ISA at the year in which the ISAv problem was most acute
Source: Own elaboration based on FAOSTAT.

The management of the epizootic by the state, and the government response in Chile, were less effective than in other countries. According to some interviewees, such as a representative from the banking sector, a bureaucrat from Sernapesca, a representative from a laboratory and an interviewed NGO, in the Faroe Islands, for example, the state took the radical decision of enforcing complete salmon depopulation for the industry. In Chile this was not the case; early harvest and the elimination of affected fish cage by cage were preferred rather than elimination by centre or the complete industry. In Scotland it was demonstrated that rapid depopulation was an important factor in eradicating the disease compared to other countries that waited for harvesting. An interviewee from the Banking Sector and Financial Advisors group opined that Chile made a good decision in this respect, because harvesting fish instead of destroying them, producers were able to generate cash flow by selling the harvest fish with ISA. A producer interviewee pointed out that at the time of the first outbreak of ISA in Chile, the sanitary authority (Sernapesca) did not have the powers to enforce depopulation of affected fish, unlike other countries. According to an interviewed lawyer, the harder measures taken for other countries were facilitated by the fact that, in other countries, there are fewer producers than in Chile. Also those countries had lower production than Chile at the time of the first outbreak, as was indicated in the previous discussion.

On the other hand, other countries implemented compensation programmes for stock depopulation, cleaning and disinfection of materials and equipment (McGeachy and Moore, 2003; McVicar, 2003): Chile did not do this. Instead of a compensation programme, the state approved a US$ 120 million security plan for salmon firms to fund sanitary investments and environmental management (Aqua.cl, 2008b; CORFO, 2013). As will be seen later in Chapter 7, this plan was strongly criticised and questioned by NGOs.

Apart from Chile, countries that are global farming salmon producers also have wild salmonid species populations. This means that in those countries the appearance of ISA led the attention of government officials and other actors (such as wild salmon fishermen) to other potential salmon populations that could be affected by ISA and the wild carriers of the disease.

3.4. Impacts of the infectious salmon anaemia in Chile and the sanitary crisis of the salmon farming industry

The ISAv and sanitary crisis produced a range of impacts at local and global levels. The impacts were observed in terms of local and global production of salmon, local exports, jobs, financial effects for the Chilean salmon producers and its suppliers, and even in the images of the Chilean industry and the country. The following sections present these impacts.

3.4.1. Production, exports and global market

In 2005 the Chilean industry was responsible for 31.6% of the global production of Atlantic salmon, Coho salmon and rainbow trout, a level that, because of the sanitary crisis, decreased to 25.8% in 2009 (FAOSTAT). Production decreased from 630,575 tonnes in 2008 to 604,963 tonnes in 2009, and dramatically fell to 466,221 tonnes in 2010 (FAOSTAT). In the same way, exports fell from US$ 2,389,637 thousand FOB in 2008 to US$ 2,098,809 thousand FOB in 2009, and 2,025,086 thousand FOB in 2010 (TechnoPress S.A., 2008, 2009, 2010; SalmonChile, 2007).

Figure 3.13 shows the production of Atlantic salmon, Coho salmon and rainbow trout between 2006 and 2010.

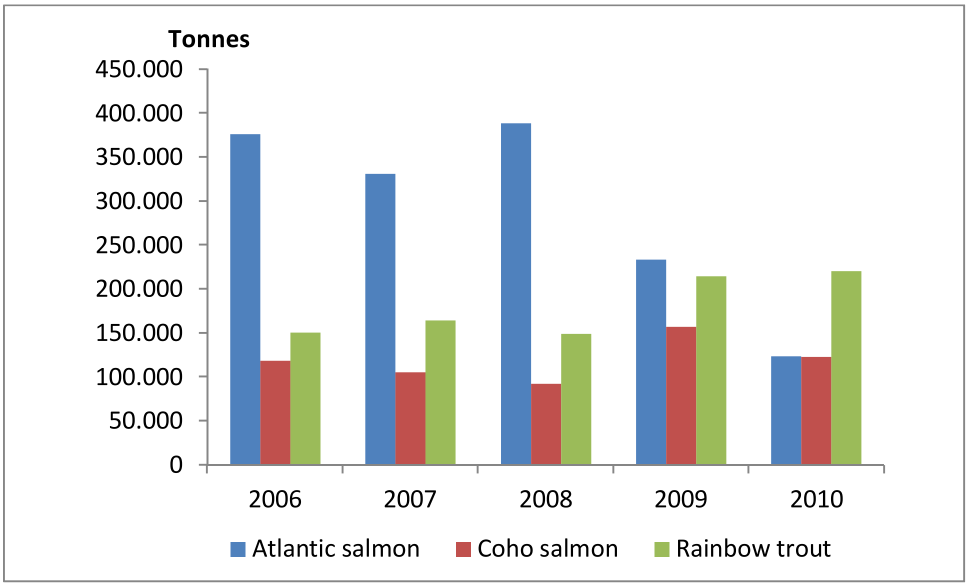


Figure 3.13: Production of main Chilean salmon species between 2006-2010
Source: Own elaboration based on FAOSTAT.

It is appreciated that the dramatic decrease of Atlantic salmon production between 2008 and 2009, a specie affected by ISA virus, caused the significant increase of Coho salmon and rainbow trout over the same period, since these species are not affected by ISAv. Like Norway, the Chilean salmon industry has become a major export sector of the country, with shipments to more than 65 destination markets in 5 continents. According to Achurra (1995), in the Chilean salmon industry there are three phases that show the importance of salmon farmed species to export. In the first phase (1982-1989) the industry focused on the Coho salmon culture. In the second phase, which began in 1990, Atlantic salmon became more important and took advantage of US market expansion. In the third phase (since 1991) rainbow trout demonstrated a significant production increase and the majority of production was intended for the Japanese market.

Of the 384,454 tonnes of Atlantic salmon, Coho salmon and rainbow trout exported in 2011, 141,645.2 tonnes was Atlantic salmon (36.8%), 112,594.9 tonnes was Coho salmon (29.3%), and 130,213.8 tonnes was rainbow trout (33.9%) (TechnoPress S.A., 2011; SalmonChile, 2007).

Figure 3.14 shows the exports for Atlantic salmon, Coho salmon and rainbow trout for the period 1997-2011.

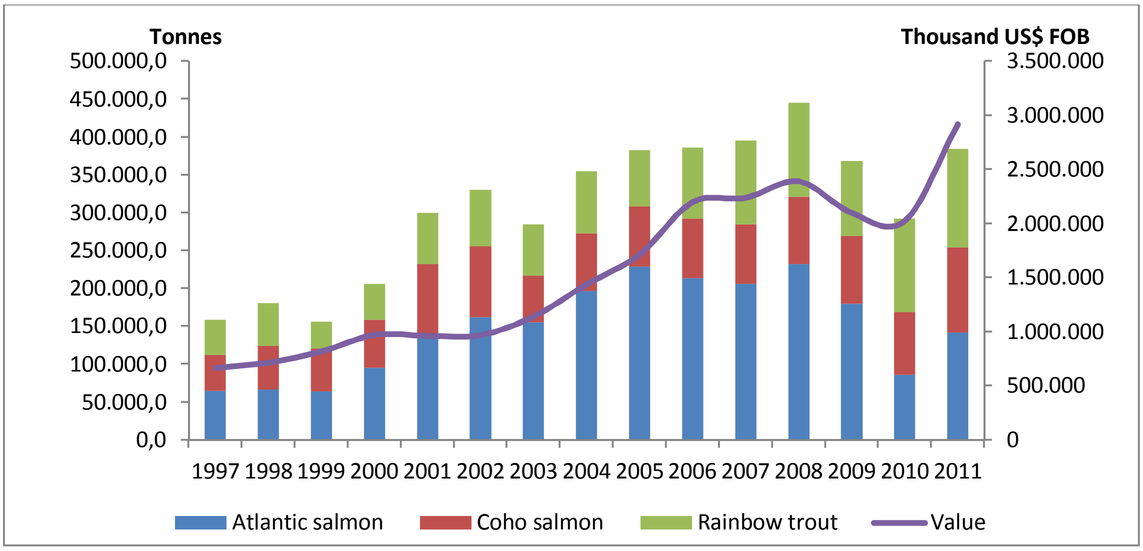


Figure 3.14: Exports Atlantic salmon, Coho salmon and rainbow trout 1997-2011
Source: Own elaboration based on TechnoPress S.A. and SalmonChile several years.

In 2006, before the ISA crisis, returns accumulated total exports equivalent to US$ 2,198,532 thousand FOB for Atlantic salmon, Coho salmon and rainbow trout, while in 2007 (the year in which the ISA crisis began) they were equivalent to US$ 2,238,014 thousand FOB for the same species, a number that tripled exports in comparison with a decade earlier (US$ 665,000 thousand). In 2010 (after the crisis), exports were equivalent to US$ 2,025,086 thousand FOB. It can be appreciated that the decrease in exports for Atlantic salmon (the specie affected by ISAv) corresponds to the increase in Coho salmon and rainbow trout, which were not affected by the virus. In 2009, 179,869.7 tonnes of Atlantic salmon were exported; this is 15.6% less than in 2006 (pre-crisis stage). In 2011 the three main species accounted similarly in the export basket of the industry in terms of quantity (141,645 for Atlantic salmon, 112,595 for Coho salmon and 130,214 for rainbow trout). However, as expected, Atlantic salmon contributed with a higher value (1,208,178 thousand FOB) compared to the other species to the total exports (TechnoPress S.A., 2006, 2007, 2009, 2010, 2011; SalmonChile several years).

In 2013, the specialised media for Chilean aquaculture, Aqua, reported that the sanitary crisis implied a loss about US$ 5 billion for the industry (Aqua.cl, 2013j). In 2008, the same media also reported that, during the first half of 2008, Marine Harvest Chile registered a loss of US$ 50.2 million in its operating profit (Aqua.cl, 2008c), and that in the same period the four firms that at that time publicly reported their results totalled losses of US$ 30.4 million. These firms as a whole profited nearly US$ 51.9 million in the same period of 2007. Aqua's view was that these four firms' costs increased due to a fall in prices, an increase in fish feed inputs (fishmeal, vegetable meal, fish oil and other vegetable ingredients) and raw materials, and worsening health conditions due to the effects of a higher incidence of diseases that affected high conversion factors and increased mortality (Aqua.cl, 2008a). In the third quarter of 2008 Multiexport reported losses of US$ 40 million, AquaChile of US$ 10 million, and Invermar of US$ 9.4 million (Aqua.cl, 2008c). The following table shows the figures.

Table 3.2: Figures of economic effects

Firm	Loss first half of 2008 (US$ million)	Profit first half of 2007 (US$ million)	Reduction in operating profit (%)	Increased costs (%)
AquaChile	11.4	24.4	4.9	14.4
Multiexport	11.4	19.1	14.8	16.5
Invermar	2.7	3.5	n/i	n/i
Yadrán	4.9	4.9	n/i	n/i

n/i: no information
Source: Own elaboration base on Aqua (2008a).

Since Chile is the second largest producer and exporter of salmon in the world, the sanitary crisis in Chile affected the global salmon market. Aqua reported that the decrease in Chilean salmon production gave the opportunity to other global salmon producers to cover the worldwide salmon deficit. According to that media, the Norwegian salmon industry benefited the most, taking advantage to expand its sales in the United States that is a key market for the Chilean industry. It was said that Marine Harvest (i.e. the Norwegian and largest firm of farmed salmon in the world) experienced both sides of the crisis. On the one hand, Marine Harvest Chile (i.e. the Chilean subsidiary) was unable to supply its worldwide customers. On the other hand, Marine Harvest ASA (i.e. the headquarters located in Norway) grew fastest in the United States market (Aqua.cl, 2009c).

The Executive Director of the Association of Salmon in British Columbia, quoted by Aqua in 2009, said that the Canadian industry in British Columbia also benefited from the sanitary crisis in Chile, but unlike Norway, it lost the opportunity to expand into the United States market due to local restrictions imposed on the salmon farming industry. According to him, Canada could not take advantage of the deficit of Chilean salmon in the United Sates because in British Columbia there are groups against the industry whose campaigns hampered the possibilities for expansion (Executive Director of the Association of Salmon in British Columbia quoted in Aqua, 10 September 2009). However, the Canadian Agriculture Division reports an increase of US$ 2,853 thousands in Canadian Atlantic salmon exports shipped to the United States between 2007 and 2008, and a decrease of US$ 3,866 thousands for the same product between 2008 and 2009.

3.4.2. Jobs

The industry has been an important source of economic activity in the region where the production takes place (Los Lagos and Aysén), but also in employment generation and labour mobility. Of the 1,200 firms involved in the industry, some 150 are key suppliers of capital goods and productive inputs, and 350 companies are in the area of services (Escobar, 2009).

In terms of the labour market, the industry added 53,400 employees in 2004, corresponding to 38,400 direct employees and 15,000 indirect employees (Infante, 2008). Figure 3.15 shows the employment evolution of the industry between 1992 and 2004.

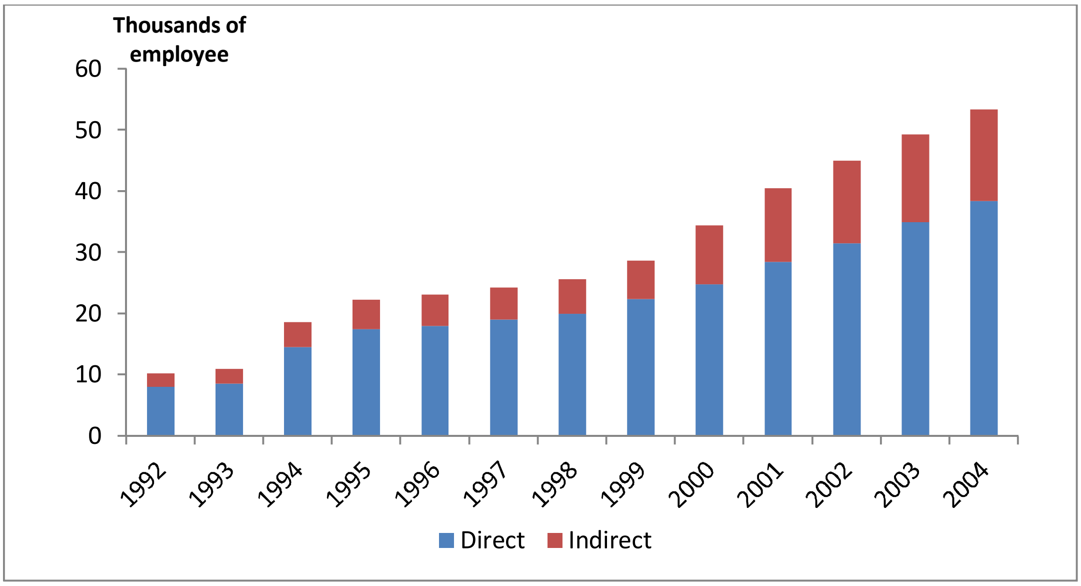


Figure 3.15: Employment between 1992-2004
Source: SalmonChile (2006).

In 2006, before the sanitary crisis, direct employees were around 30,000 (El Mercurio.com, 2010). The lay-offs in the industry began in December 2007. The first workers dismissed were from the firm Marine Harvest (the first firm experiencing the virus and reporting it to the authorities) (Bórquez, 2009; OLACH, 2013). The spread of the virus resulted in massive lay-offs, together with the closure of some farming centres and processing plants (Aqua.cl, 2008d). This situation triggered a series of demonstrations by workers against the firms, claiming mismanagement of the situation. It even led to the shutting down of some production facilities by workers (Aqua.cl, 2008i; Aqua.cl, 2008g). In December 2008 the industry had already lost about 10,000 jobs (Bórquez, 2009).

In 2010, after the sanitary crisis, the industry had 18,000-19,000 direct employees, which represents around 40% less in comparison with the figures for the labour force at the pre-crisis stage (El Mercurio.com, 2010).

3.4.3. Financial effects for the industry

The significant drop in salmon production led to the industry defaulting with its creditors (i.e. the banking sector) and suppliers. This situation sparked off negotiations between the industry and banking sector, which were part of the consequences of the policy response to the crisis. The industry default was given because a drop in production was translated into a drop in sales and exports. In simple terms, producer firms could not generate sufficient money to pay back money that they borrowed from the banking sector or to pay to their suppliers. Also, and as a consequence of this, the banking sector was unwilling to lend more money to the industry. This aggravated the financial situation for the industry.

For many years salmon producers had good access to financing from banks, with a risky, but accepted by creditors, collateral that was the biomass (i.e. the fish in the water). However, this situation changed radically with the emergence of ISAv that caused high mortality in fish farms (Chilean National Congress Library, 2010d). Banks realised that the biomass was no longer reliable collateral. At the same time the ISAv demonstrated to the banking sector that the salmon industry was exposed to a great number of risks, of which viruses and diseases are just one. Environmental factors and natural disasters such as earthquakes, tsunamis, volcanic eruptions, storms and algal blooms to name a few, as well as risk factors from the aquaculture activity itself, such as attacks from South American sea lions (Otaria flavescens) on salmon cages, salmon escapes and salmon theft are part of those risks. All these risks may affect either the biomass or the profitability of the salmon production (Claro y Asociados, 2009). It was clear that ISAv, diseases and sanitary problems were never taken into account for risk assessment from the banking sector about the salmon industry. The sanitary issues were underestimated and this had to change to find a long term solution that allowed the survival of the industry.

The General Manger of the Association of Banks (ABIF for its Spanish acronym) pointed out that the salmon crisis revealed that a sustainable approach was needed with a greater focus on biosecurity. At the same time, there was a need to modify some legal aspects to have collateral in accordance with the diverse industry risks. In May 2009, 12 creditor banks were involved with aquaculture firms (Chilean National Congress Library, 2010d).

In 2009 the Association of Banks employed an external consultancy firm, Claro y Asociados, to study the state of salmon industry in financial, sanitary, commercial and legislative terms (Claro y Asociados, 2009). In May 2009 it was pointed out that the direct debt from the industry to the banking sector was approximately US$ 1,600 million, whilst the indirect debt (from suppliers) was approximately US$ 400 million (Chilean National Congress Library, 2010d). However, the report from the external consultant specified that in June 2009 the direct debt was between US$ 2,200-2,400 million, whilst the indirect debt (from suppliers) was approximately US$ 1,000million (Aqua.cl, 2009a).

3.4.4. Effects in supplier firms

Some interviewed supplier services mentioned that during the sanitary crisis a great deal of attention was paid to the effects of the crisis in terms of the salmon producers and workers (unemployment). They argue that the problems the producers were facing (sanitary and financial) were prioritised, and much less attention was paid to the effects of the crisis on the supplier firms and the problems they were also facing.

Supplier firms for the salmon industry are composed of both service and product suppliers. As mentioned in the previous section, as of June 2009, supplier firms had taken loans of between US$ 400 million and US$ 1,000 million from the banking sector.

Interviewed service suppliers reported during fieldwork that since supplier firms are directly dependent on producer firms, a lack of production due to fish mortality and their resulting financial difficulties had major repercussions for supplier firms. The clearest repercussion was the default of the producers with their suppliers. Mentioned by interviewees, but also pointed out by Vera (2010), the Chilean salmon industry is one based on outsourcing. According to Vera (2010) the high specialisation, development and innovation that the industry takes pride in comes from the supplier firms. However, there is a lack of trust, alliances, collaboration and incentives between producers and suppliers that have been strongly criticised by supplier firms (Vera, 2010). According to an interviewed service supplier, the incentive for suppliers is to offer sub-standard products and services due to salmon producers' continuous attempts to reduce costs, which leads to choosing cheaper suppliers.

Suppliers interviewed during fieldwork explained that there is also a long term problem that suppliers must deal with, and that was exacerbated during the sanitary crisis;–this was the excessive delays in payment to suppliers from producers. An interviewed service supplier explained that supplier firms paid a high cost with this sanitary crisis. He said that for every employee that lost his job in a producer firm or process plant, three employees lost their jobs, or were negatively affected, in supplier firms in economic terms. He continued, arguing that suppliers resisted the sanitary crisis and acted, in part, as banks for the producer firms, and that delays in payments for them were for four, five, six or seven months, and sometimes one year. He finished saying that the delay in payments on accounts receivable for suppliers were much longer than for the producers, the recovery for suppliers was longer than for producers (probably two or three years more than for the producers), and that there were, and always have been, delays in payments to suppliers from producers, but the requirements for suppliers are day-by-day.

3.4.5. Industry and country images

For politicians and industry representatives the salmon industry has always been portrayed as an example of success and a reason for pride to be shown abroad highlighting the Chilean natural resource advantages. In their Presidential messages the country's Presidents have pointed out the salmon industry as one of the productive engines to contribute to the Chilean growth (Lagos, 2002), and as one that should be principally promoted for the country (Bachelet, 2008). Explaining the contribution of the salmon cluster to the country's competitiveness, the General Manager of the Association of Salmon Industry stated with some pride that one out of four salmon consumed in the world is Chilean salmon (Infante, 2008).

The ISA crisis affected not just the economic performance of the Chilean industry and country but also their international image. On 27 March 2008 *The New York Times* published an article about how ISAv indicts the aquaculture methods in Chile and the practices that led the industry to the emergence of ISAv in Chile. The article points out several issues on industry practices, emphasising the abuse in the use of antibiotics, lack of sanitary controls, contamination of the water, and overcrowding of fish pens, among other issues.

It was reported by the press that this article influenced Safeway (a larger retail in the United States) to restrict its sales of Chilean salmon coming from the firm Marine Harvest in Chile (Chile Potencia Alimentaria, 2013). Although not all Chilean salmon firms sell their products through this large retail chain, it was a very negative signal to national and international markets. According to the press, Safeway explained that they restricted the purchase of Chilean salmon from areas affected with ISAv because it was affecting the quality and size of the product. The press also reported that there was a significant drop in local shares linked to the salmon industry[28] that was attributed to the decision of Safeway in the United States, and the questionable sanitary controls that the Chilean salmon firms would have posted in *The New York Time* article (El Mercurio.com, 2008b; Diario Financiero.cl, 2008).

Some Chilean newspapers of the period, such as El Mostrador, Diario Financiero and La Nación, reported that the Chilean salmon industry and Chilean government reacted quickly to the accusations posted by *The New York Times* to reduce the impact on Chilean salmon sales in the United States, since this situation could influence consumer perception of Chilean salmon and other Chilean products. These local newspapers also reported that the industry contacted the Treasury, Ministry of Economy, Foreign Office and Home Office to promote a contingency plan. Also that salmon representatives announced in an informative publication in the key newspapers in countries where Chilean salmon was sent to clarify the information posted by *The New York Times* that they considered as false. These newspapers pointed out that the President of the Association of Salmon Industry (SalmonChile) mentioned that another measure that could be taken would be to take legal action against the researcher who was interviewed for *The New York Times*. The researcher mentioned to the media that the high overcrowding of fish would increase sanitary risks for the industry. The industry also perceived the situation as part of a long term campaign against the industry from environmentalists and NGOs.

On the other hand, these newspaper articles mentioned that the President of Chile assigned the Coordinator of Country Image to coordinate the measures to be used to defend the image of Chilean exports with the industry. The government also delegated the issue to the Ministry of Economy who contacted the industry to elaborate on a national and international plan to face the situation. According to the newspapers, the Chancellor was also involved from the government and the Undersecretary of Fishing (Subpesca by its Spanish acronym) and General Directorate of International Economic Relations (for its Spanish acronym Direcon) prepared a

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[28] In particular, the shares of Invermar fell 4.9% and Multifoods 3.9% (El Mercurio.com, 2008b).

public declaration on behalf of the government. The government also asked salmon producers to clarify every point of what *The New York Times* article had stated.

The ambassador of Chile in the United States sent a letter to *The New York Times* saying how it damaged this successful industry and that some accusations against the Chilean industry were false (El Mostrador.cl, 2008; Diario Financiero.cl, 2008; La Nación.cl, 2008).

Reported by La Tercera, on 20 April 2008, less than a month after *The New York Times* article was published, personnel from the Food and Drug Administration (FDA) visited Chile to examine the production systems in the Chilean salmon industry. This visit was very welcomed by both the Chilean industry and the government in their aim to reduce the distrust that clients and consumers might have about the Chilean salmon industry and Chilean products (La Tercera.com, 2008).

As noted by Barton and Fløysand (2010), *The New York Times* article showed the globalisation of sustainable development issues. The new challenges on sustainability are not country localised but involve diverse groups of globalised actors in the debate. The impact of the ISA crisis on the image of the Chilean salmon industry and the country at national and international levels, showed the boundaries of the industry and the boundaries of sanitary, environmental and sustainability debates through the mobilisation of a diverse group of actors (press, industry, government, ambassador, researchers and environmentalists).

3.5. Synthesis of the chapter

Chile is the second largest producer and exporter of farmed salmon in the world after Norway, an achievement that was made possible by an intensive production model based on the exploitation of the natural common-pool resource water. The country mainly produces and exports three different types of salmon species: Atlantic salmon, Coho salmon and rainbow trout. In 2007 the Chilean industry was affected by the infectious salmon anaemia, a viral disease of marine-farmed Atlantic salmon caused by the ISAv. The country was the last of the global salmon producers to experience ISAv. At the time Chile got the virus it has been reported over a long period, the first time being in Norway in 1984.

Although ISA does affect Atlantic salmon, Rainbow trout and Coho salmon can act as reservoirs of the virus. It has been demonstrated that the sea lice caligus acts as a vector. Like ISAv, the caligus affects the Atlantic salmon, Coho salmon and trout in different ways. The susceptible species for caligus are Atlantic salmon and rainbow trout. Certainly the presence of caligus in the industry helped to disseminate the ISAv, which once introduced into the country rapidly spread across the industry.

Before the emergence of ISAv, a decrease in the productivity of the industry was observed. This suggests, on the one hand, that the sanitary crisis was partially a man-made event because the decrease in productivity was inadequately managed to some extent by an increase in fish density, which led the industry to exploit more intensively the natural resource water. On the other hand, it suggests that, although the first outbreak of ISAv suddenly appeared in 2007, the conditions to reproduce the virus had developed progressively over a long period. In this way the decrease in productivity and the emergence of ISAv can be considered as implications of a production-intensive model.

When ISAv was confirmed in Chile, outbreaks became a priority issue in the government decision-making agenda, and it was understood that additional specific measures were needed to respond to the virus. Vaccines were not available in the country, nor did the sanitary, environmental or other regulations include specific measures to deal with ISAv. The development and implementation of responses were delayed, partially due to the virus being dismissed as a serious sanitary industry problem at the beginning, there was some ignorance in diagnosing the disease, and it took time to get international confirmation of the disease.

The sanitary crisis impacted negatively on the Chilean industry. The participation of the local industry at a global level decreased due to the dramatic drop of Atlantic salmon production. However, since ISA does not affect Coho salmon and rainbow trout, there were increases in the number of these species, which have less commercial value than Atlantic salmon. The significant lower production of salmon resulted in massive lay-offs, together with the closure of some farming centres and processing plants. Since the industry has been an important source of economic activity, employment generation and labour mobility in the southern regions where the production takes place, the sanitary crisis also caused a social crisis. Moreover, the ISA crisis affected the international image of the local industry and the country. This exemplary, successful industry was severely questioned internationally for its practices. Senior government officials and industry representatives were actively involved in several image campaigns.

The significant drop in salmon production that affected exports led to the industry defaulting with the banking sector and suppliers. Producer firms could not generate sufficient money to pay back money that they borrowed from the banking sector nor pay their suppliers. With the industry sanitary crisis the banking sector realised that the biomass (fish in the water) was no longer reliable collateral for them, and at the same time it demonstrated that the industry is exposed to a great number of risks of which viruses and diseases are just one. It was clear to the banking sector that sanitary issues were underestimated and this had to change to find a long term solution that allowed the survival of the industry. It was pointed out that the salmon crisis revealed that a sustainable approach was needed with a greater focus on biosecurity and a need to modify some legal aspects to have collateral in accordance with the diverse industry risks. These issues were part of the policy responses to the crisis.

There are three main differences between the Chilean sanitary crisis and the sanitary crises of other global salmon producers. Firstly, at the time of the sanitary crisis in Chile, the Chilean industry was considerably larger in size compared with other global salmon producers when they experienced the crisis. Because of this, the economic loss to the Chilean industry was greater than the other global producers. Secondly, the management of the epizootic by the state, and the government response in Chile, were less effective than other countries. Finally, since other global salmon producers also have wild salmon species, the appearance of ISA led the attention of government officials and other actors (such as wild salmon fishermen) to other potential salmon populations that could be affected by ISA and the wild carriers of the disease.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

"One can often generalize on the basis of a single case..."
(Flyvbjerg, 2006 p.228)

This chapter presents the research design and methodology employed in this study. The first part of the chapter discusses the case study as the chosen research method. The second section explains the selection of the sanitary crisis of the Chilean salmon farming industry as the case study, and how the research context was organised. Section 3 discusses the reliability and validity of qualitative research, and Section 4 the generalisability from a single case study. The research strategy, operationalisation of the research questions and key concepts are explained in Section 5, whilst Sections 6 and 7 present the sources of data and information, and data and information collection, respectively. At the end of the chapter, Section 8 discusses the data and information analysis.

4.1. Case study as a research method

In the literature of research methods there is no common and agreed definition of case study. Gerring (2004) refers to some definitions[29] and concludes that what researchers have defined as case studies are actually characteristics of types of case studies rather than what a case study is itself. Similarly, Ragin (1992) recognises different conceptions and understandings about what a case study is and proposes a conceptual map to conceptualise and understand case studies. In this conceptual map there are two conceptions and two understandings about what is a case study. In the conception dimension a case study can be specific (i.e. it emerges through the research) or general (i.e. it exists prior to the research). In the understanding dimension a case study can be understood as an empirical unit (i.e. it is 'out there') or a theoretical construct (i.e. it is constructed from the theory). Although the authors propose this classification they recognise it is not absolute and might overlap with other conceptions and understandings about what a case study is. At the same time, in an attempt to define case studies according to their functionality, Stake (1995) classifies them into intrinsic (i.e. it is given

[29] Such as qualitative method, small sample, participation in the field (Yin, 1994); research characterised by process-tracing (George and Bennett, 2004); research investigates a process of a single case (Campbell and Stanley, 1963; Eckstein, 1975); research investigates a single phenomenon, instance or example.

or there is a need or curiosity to learn about a particular case) and instrumental (i.e. it is used as an instrument to understand other cases)[30].

The research method literature points out traditional prejudices against case study as a research method (Yin, 2009) or misunderstandings about it (Flyvbjerg, 2006). One of these prejudices or misunderstandings is to believe that case studies are more useful as a preliminary research method in a research process. This is, case studies are better for generating hypotheses or in an exploratory phase of the research, whilst other methods are more useful for testing and building theory. Therefore they are applied in later phases of the research such as the descriptive or explanatory phases (Flyvbjerg, 2006; Yin, 2009). Flyvbjerg (2006) explains that this misunderstanding comes from the belief that it is not possible to generalise from individual cases or, as Yin (2009) notes, there is a common concern about the limits to scientific generalisation in case studies. In order to correct this idea Flyvbjerg (2006), Yin (2009) and Kennedy (1979) clarify the manner and conditions under which generalisation from case studies can be made (see Section 4.4 where this point is treated in detail). Yin (2009) concludes that each research method can be used in all the phases of a research process: exploration, description and explanation.

This research aims to explain how the policy response to the sanitary crisis in the Chilean salmon farming industry evolved through processes of learning linked to institutional change, and with this to extend the policy learning and policy change literature. To do so, it used the case study as the research method. This study adopted the approach proposed by Yin (2009) as the rationale to select the case study as the research method because it illuminates what a case study is; at the same time it gives insights into what a case study does (i.e. functional role of a case study) and what a case study is good for (i.e. the pertinence of its use).

In Yin's approach a first step to identify the most relevant research method is to reflect on how the research questions have been formulated according to the research topic and the phenomenon to be studied. When research questions are formulated into 'who', 'what', 'where', 'how many' and 'how much' frames, sometimes they are being used in an exploratory or descriptive way. In that case, the questions are likely to be answered using a survey or archival analysis. However, when research questions are formulated into 'how' and 'why' frames they are more suitable to be answered with a case study, history or experiment research method because the questions are suggesting a more explanatory approach to study

[30] Ragin's conceptual map and Stake's classification use the same foundation to understand case studies.

the phenomenon. This research posed ‘how’ questions (see Section 2.8) to be answered and therefore case studies, histories or experiments are suitable to answer them.

The second step in Yin’s approach refers to reflecting on the degree of control the researcher has over the phenomenon, that is, whether the research can control the conditions and environment in which events occur. When it is possible to control conditions and environments, experiments are more suitable as a research method than histories or case studies in which the control of the event is not possible. Since, in this research, the researcher could not control the conditions or environment in which the phenomenon occurred, histories and case studies are more suitable as research methods.

Finally, the third step refers to the time focus of the phenomenon. That is, whether the phenomenon is linked to a contemporary or historical event in terms of a researcher’s access to the events. When the phenomenon is contemporary, case studies are more suitable as the research method since the researcher has access to the events by direct observation[31], and/or by access to participants who were involved in the events. Since this research studied a contemporary phenomenon and the researcher had direct access to it via participants involved in that phenomenon, case study was the most suitable research method to conduct the research.

According to Yin (2009), a case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real life context, especially when the boundaries between phenomenon and context are not clearly evident” (p.18). The aim of this research is to explain in depth the contemporary real-life phenomenon of how actors responded to the sanitary crisis in the Chilean salmon farming industry through processes of learning and institutional change in which context conditions are crucial to understand the phenomenon.

According to Flyvbjerg (2006) the real life sense and context-dependent knowledge provided by case studies are valuable characteristics to conduct good research. As they allow proximity to the reality and connection with concrete situations, they help to develop relevant skills and experience to achieve a more general or theoretical knowledge (context independent knowledge). As part of the case study as a research method Yin (2009) mentions two additional characteristics that case study research has: i) case studies rely on multiple data sources and data contents converge via triangulation (see Section 4.6), and ii) data collection and data analysis are guided from theoretical propositions (see Sections 4.7 and 4.8). The use

[31] Histories cannot use this method since the events occurred in the past where the researcher has no direct access by taking an active role in developing the material by directly interrogating the participants.

of multiple sources of evidence and triangulation as a way of achieving data convergence is crucial in establishing research validity and verification. This is an important issue in case study research since another traditional prejudice is to believe that case studies have a tendency to confirm researchers' preconceived ideas. However, as Flyvbjerg (2006) explains all research methods may have bias toward verification of a researcher's preconceived ideas, and case studies do not intrinsically have greater bias than other methods. Case studies may contain greater bias toward falsification of researchers' preconceived ideas than toward verification (see Section 4.4).

4.2. Case study selection and organisation of the research context

A criterion for selecting cases is to choose them to confirm, challenge or extend the theory (Yin, 2009). On this basis cases are selected by theoretical purposes (Eisenhardt, 1989) using an information-oriented selection strategy, with which it is intended to achieve the greatest possible amount of information in order to gain a deep understanding of the studied phenomenon (Flyvbjerg, 2006). Following this strategy the policy response to the sanitary crisis in the Chilean salmon farming industry was identified as a suitable case to analyse and test the framework on policy learning and policy change stimulated by catastrophic events developed in Chapter 2. However, the study of this case also contributes empirically to the literature on the Chilean Salmon Industry in which it is important (i.e. for economic, social and environmental development reasons) to address issues of industry sustainability, which are even more important since the sanitary crisis.

Therefore, the selection of the case study was a combination of an intrinsic and instrumental choice (Stake, 1995). On the one hand, there was an interest to learn and contribute empirically to a deep understanding of the sanitary crisis and the policy response to it in the Chilean salmon farming industry. At the time this research began, few studies on the sanitary crisis of the Chilean industry had been conducted (e.g. Barton and Fløysand, 2010; Iizuka and Katz, 2010), and no studies or policy analysis of the policy responses to the crisis and their consequences could be identified by the researcher.

The following statements are the main rationales for selecting the policy response to the sanitary crisis in the Chilean salmon industry as a single country case study (Yin, 2009):

1. The policy response to the sanitary crisis in the Chilean salmon industry is a critical case for analysing policy learning and policy change processes. The features of the industry and the phenomenon studied allow the testing of specific propositions and the conditions under which they are valid or believed to be true. Specific features, such as the global boundary of the industry, its fragmentation and heterogeneity, as well as the contested issues and interests among actors with science and technology content (the resolution of which must be appropriate to provide solutions for this industry after its crisis), exist in other industries. Therefore the generalisability of this case can be increased. Also, although the phenomenon studied represents a localised problem, some processes are likely to be reproduced in other contexts and times. Thus, this research is a significant contribution to lessons to be learned in policy terms and on the value in anticipating catastrophic events like crises.

2. The policy response to the sanitary crisis in the Chilean salmon industry is a longitudinal case. The study organises the empirical context in three phases (see below) in order to observe and analyse how policy learning and policy change took place.

3. The intensification of natural (common-pool) resource use represents a tendency of modern development, where the intensive exploitation of a biological system to support efficiency and profitability affects the environment, thus threatening the sustainability resource use and the long-term development of industries. The Chilean salmon industry is an emblematic case of an intensive natural (common-pool) resource model. However, this case is not exclusive for the salmon industry. As the salmon industry is embedded in the aquaculture sector, and the aquaculture sector is embedded in agribusiness, this case may apply to other industries in agribusiness in which an environmentally sustainable resource use is needed. Also since the Chilean salmon industry is a global one, it is a good example of how development has occurred (intensification of the use of a natural, common-pool, resource). These elements increase the range of generalisation from this research.

4. The selected research case involves more than one unit of analysis and therefore it corresponds to an embedded single case study (Yin, 2009). The higher level of analysis is the industry as a global unit; however, the analysis also involves disagreements and conflict among different actors over policy issues. Although this research considered a single country case study, comparisons between the crisis and legislative process of the Chilean context and others (e.g. Norwegian and Scottish process) were background or context type of comparison.

The context to analyse the policy learning and policy change processes stimulated by the sanitary crisis of the industry was organised into three phases, which are explained in section 4.5. The following figure demonstrates the organisation of the context.

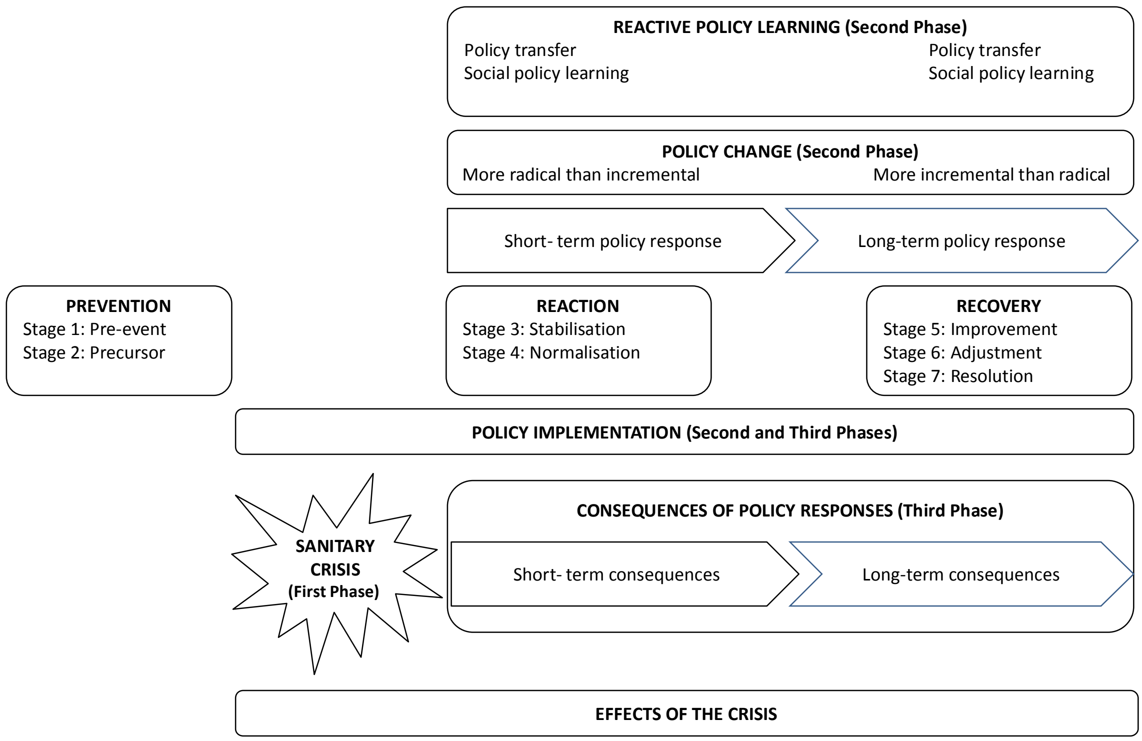

Figure 4.1: Organisation of the empirical context

Source: Own elaboration based on Rose (1991), May (1992), Hall (1993), Matland (1995), Faulkner (2001) and Kingdon (2003).

The starting point in analysing the empirical context is at the onset of the sanitary crisis in 2007 until the time after the crisis when the policy responses were put into practice and some consequences of those responses could be observed, 2013. Earlier periods that cover the history of the industry, the implementation of the First General Law of Fishing and Aquaculture (Law N°18892), and the socio political and economic context of the country are considered as background information.

The publication of the initial law (Law N°18892) in 1989 is an important milestone for the industry. This law is the basis of the organisation of the responsibilities and regulations related to the sustainability of the aquaculture sector in Chile, and the most relevant law on which the Chilean salmon industry built its export-oriented trajectory. This period of time has been chosen because it covers the period of the industry crisis (2007-2010) completely, and informs about the export-oriented developments of the industry. Also, as Sabatier (1993) and Sanz (1995) point out, policy learning and policy change need time to be studied. At least ten years should be considered to study the success or failure of a policy, i.e., once a cycle of formation, implementation and reformation has been completed.

In 2007 the infectious salmon anaemia virus was introduced in the Chilean salmon farming industry causing the worst sanitary crisis in the history of this industry. The crisis demonstrated that the way in which the industry was operating was no longer viable, and that urgent measures were needed to address the crisis itself, the problems revealed by it, and its effects. The crisis gave evidence of policy failure because it demonstrated that the established policy could not protect the industry from a virus (which was not new in the world), nor was it effective in dealing with or controlling the virus once introduced. In the short-term, policy responded dramatically directly to the crisis and these short term measures were followed by further measures. The theory reviewed in Chapter 2 suggests that the short term measures were more likely to be radical and the longer term measures were more likely to be incremental in nature. However, whether this is true in the case being studied is an empirical question. Similarly, it is a question as to whether policy responses to the crisis had different consequences for industry actors in the short and long terms.

4.3. Reliability and validity in qualitative research

Reliability is generally related to the replicability of the research findings. This is whether or not the research findings would be repeated if another study was conducted using the same or similar methods (Lewis and Ritchie, 2003; Silverman, 2006).

This research employed the two ways suggested by Moisander and Valtonen (cited in Silverman 2006, p.282) to satisfy reliability in qualitative research. These are:

1. Research process transparency by explaining the research strategy and data analysis in detail (see Sections 4.5, 4.6, 4.7 and 4.8).

2. Theoretical transparency by making the theoretical lens employed to interpret the data and findings explicit, and explaining how the chosen theoretical lens allows those interpretations excluding others (it has been applied in the construction of the theoretical and conceptual framework).

The research design was also constructed with aim of validity. Validity in qualitative research is concerned with ‘correctness’ or ‘precision’ and quality of the research in its data-sources and methods of collection (construct validity), claims, statements and data analysis (internal validity), and in the extent to which the findings are applicable to other contexts or settings (external validity) (Lewis and Ritchie, 2003; Yin, 2009).

This research used the three tests pointed out by Yin (2009) that can be applied to ensure validity in qualitative research: construct validity, internal validity and external validity. Construct validity refers to the identification of operational measures to the phenomenon under study. Thus, the policy response to the sanitary crisis (phenomenon under study) has been defined in terms of specific concepts, such as policy learning and policy change, which are related to the objectives of the research. Changes in policy goals, policy instruments, or the settings of policy instruments, have been defined as measures that operationalise those specific concepts (see Section 4.5).

Internal validity corresponds to the establishment of causal relationships in the data. Analytical tactics, such as constant comparative methods and deviant case analysis, have been used in the data analysis (see Section 4.8) to achieve internal validity. External validity is concerned with the generalisation of the findings. This was achieved through the theories employed and demonstrated in the literature review chapter (Chapter 2). Since this research used a single case study as its research method and there may be some concerns about the generalisability of this study, external validity or generalisation is treated in more detail in Section 4.4.

In addition validity requires a careful consideration of the robustness of evidence used to draw conclusions. Triangulation is a general tool to build validity in qualitative research. It refers to the use of multiple sources of evidence, which helps to develop what Yin (2009) calls 'converging lines of inquiry'. His argument is that "findings or conclusions are more likely to be more convincing and accurate if they are based on several different sources of information, following a corroboratory mode" (Yin, 2009 p.116). Mabry (2008) points out different methods of triangulation for data collection and data analysis[32]. Based on this guidance, this research employed triangulation by data source and triangulation by method of collection in the assembly of evidence, whilst in the data analysis it used theoretical triangulation.

[32] Those methods are triangulation by: data source, method, time, observer and theory (Mabry, 2008).

4.4. Generalisability in qualitative research and from a single case study

In qualitative research generalisation concerns the potential for drawing inferences or extending the application of findings from the immediate case study to wider populations, contexts or theories (Lewes and Ritchie, 2003). Lewes and Ritchie (2003) define two types of generalisations. The first is a context dependent type of generalisation called 'empirical or inferential' generalisation. This refers to the application of findings from specific cases or studies to populations or settings beyond the particular sample of the study. The second is a 'context-free' type of generalisation called 'theoretical' generalisation. This refers to the generation of theoretical concepts or positions with wider or universal applications.

Single case studies have been a matter of concern in qualitative research in terms of their potential value for generalisation and contribution to scientific knowledge. However, Flyvbjerg (2006) points out that it is incorrect to conclude that it is not possible to generalise from an individual case, or to conclude that a single case study cannot contribute to scientific development. He argues that single cases can be crucial in revealing 'falsification', that is, in revealing that something is false when actually it is generally considered true or valid. He says "case study is well suited for identifying 'black swans' because of its in-depth approach: what appears to be 'white' often turns out on closer examination to be 'black'" (Flyvbjerg, 2006 p.228). Similarly, Kennedy (1979) points out that, more important than the number of cases studied is the range of attributes that a case has and the range of conditions under which observations occur in that case. Then, more generalisation is not necessarily achieved by increasing the number of cases studied. Thus, criteria for generalising from single cases are related to the attributes of those cases.

Kennedy (1979) states that a key criterion for generalisation from case attributes is the relevance of these attributes. In the case study, this relevance is driven by the research questions or hypothesis of the study. The range of generalisation is set by defining the attributes of the case in order to compare them with the attributes of other cases. Those other cases that have the most similar attributes (i.e. those cases that are most analogous) are more suitable to be generalised from the case. In this way, the validity of the generalisation rests on the extent to which the attributes compared among cases are relevant.

However, this claim is grounded in the premise that the case chosen is not an outlier or idiosyncratic case of a general phenomenon: in the case of this research, the general phenomenon of resource intensive industry development. A qualification of the research presented in this thesis is that the under-development of the literature on policy making in response to crisis makes it difficult to claim that the case of the policy response to the sanitary crisis in the Chilean salmon farming industry is free of idiosyncratic features that might limit its generalisation. This means that the scope for comparison is limited. Thus, the conclusions drawn from this thesis offer a potential opportunity for further research, and in this sense contribute to the advance of knowledge.

4.5. Research strategy and operationalisation of research questions and key concepts

The research strategy to operationalise the theoretical framework and answer the research questions posed in Section 2.5 involves three phases. In the first phase, using an adaptation of the system failure approach (Woolthuis, Lankhuizen and Gilsing, 2005) and causal stories (Stone, 1989), a characterisation and diagnosis of the Chilean salmon industry was conducted to understand the nature of the crisis and its relationship with the structural characteristics of the industry at the time of the crisis. In the second phase, the policy responses to the crisis were analysed using a policy learning and policy change approach (Hall, 1993; May, 1992; Kingdon, 2003) in order to explain how a policy learning process in the industry was precipitated by the crisis. Finally, in the third phase the consequences of the policy responses to the crisis were analysed from a 'conflict and ambiguity' perspective. In this perspective, the conflict emerges from inconsistent views that actors have when more than one actor sees a policy as directly relevant to his interests, whilst ambiguity occurs when there is misunderstanding of policy goals or roles of bureaucrats, as well as uncertainty in the resources to perform the activities to implement the policy (Matland, 1995).

In those phases, policy learning in a context of industry crisis was the dependent variable, and how policies changed (i.e. changes in policy goals, policy instruments or settings of policy instruments) was used as the explanatory variable to understand the institutional change after the sanitary crisis in the Chilean industry.

As explained in Chapter 2, there is no a single definition about policy learning and policy change. There are also different ways in which those concepts have been defined and conceptualised (e.g. rational process, bounded rational process) in the literature. This research employs an adapted definition of Hall's policy learning to explicitly indicate that, in the case of the Chilean salmon industry, the policy responded directly to the crisis and indirectly to past experience and new information. Policy learning to this research means 'a deliberate attempt to adjust the goals or techniques or instruments, or to establish new goals and create new techniques of policy in direct response to external dramatic events such as crises and indirectly to past experience and new information'.

Following Hall´s conceptualisation of policy learning, this research observes policy change as the changes in policy goal, policy instruments, or the settings of policy instruments. Changes in policy goals or alterations in the hierarchy of policy goals behind policy are understood as radical policy change or paradigm shift, whilst changes in policy instruments and changes in the settings of policy instruments are understood as incremental policy change. The co-evolution of the changes in policies with the sanitary crisis was made following the evolutionary stages of the crisis: stabilisation, normalisation, improvement, adjustment and resolution.

It is an empirical question whether policy learning at any of the crises stages can be associated with radical or incremental change, and whether this occurs in fact in the case of policy response to the sanitary crisis of the Chilean salmon farming industry. For the reasons given in Chapter 2, it might be expected that the short-term policy responses, and the policy learning associated with these short-term responses, give rise to a greater likelihood of radical policy change. Similarly, it might be expected that the long-term policy responses, and the policy learning associated with these responses, give greater opportunity of incremental policy change.

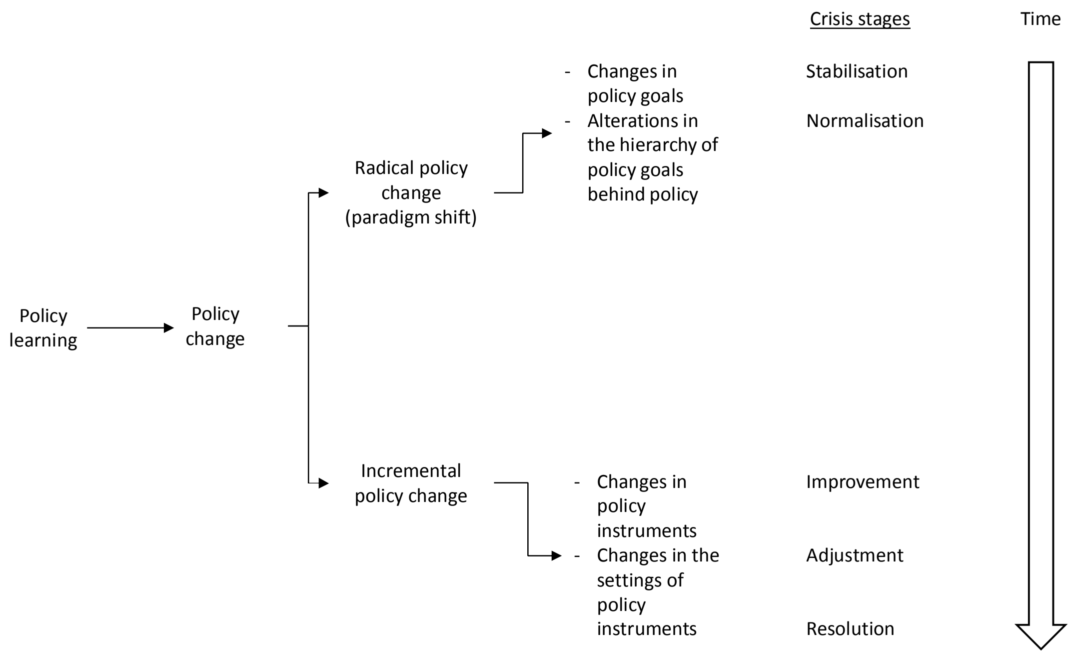

Figure 4.2: Operationalisation of research questions and key concepts
Source: Own elaboration based on May (1992), Hall (1993) and Faulkner (2001).

4.6. Sources of data and information

This research employed primary and secondary sources of data and information. The primary source data was gathered from a complete set of actors interviewed from April to July 2011.

Actors to be interviewed were selected through a purposive sample that was driven by the aims and research questions of the study, as well as the theoretical framework that identified the key concepts to be covered and the characteristics of the processes under study (Ritchie, Lewes and Elam, 2003). The sample was focused on the actors that strongly represented the phenomenon to be studied in the research. These actors were those who were participating in the processes of diagnosing the industry crisis, policy responses to the crisis, including the modification of the initial Fishing and Aquaculture Law (Law N°18892), and the consequences of those policy responses. Critical actors to be interviewed were those who demonstrated a pivotal role in framing the policy problems, choices and outcomes of the policy response, as well as dissident positions to reach consensus over policy issues.

Given the heterogeneity of the industry and the diversity of participants involved in the phenomenon, the sample size considered 10 groups of actors. These actors were: i) Bureaucrats, ii) Public Agencies, Programmes, Institutes, Councils and Services, iii) Private Institutes, Foundations and Consortia, iv) Interest Groups subdivided into NGOs, Associations and Trades Unions, v) Government decision makers, in this case senators and deputies, vi) Producers Firms, vii) Supplier Services subdivided into Consultants, Lawyers, Laboratories and Veterinarians, Transport and Product Process, viii) Media, ix) Universities, and x) Banking Sector and Financial Advisors.

The groups Trades Unions, Lawyers, Laboratories and Veterinarians, and Transport and Product Process, were not considered at the beginning of the research design but were added during fieldwork. During fieldwork some themes such as the disagreements of industry workers on policy responses, the development of specific industry regulation, industry practices, such as the use of vaccines to control ISA, and industry logistics emerged. These themes were crucial in the design and delivery of policy responses after the crisis, and suggested that the opinion of these participants was relevant.

The way in which the sample was framed ensured the required diversity of actors to optimise the identification of factors and characteristics of the phenomenon, as well as the relationships and interdependency among the key concepts to be covered. The diversity of participants helped to achieve a range of responses on the interview questions and to avoid biased answers. There were no major challenges in the identification of key interviewees because they were all well known. However, the public document 'history of the Law N°20434', which records the process of modification Law N°18892 (as part of the process under study) at parliamentary level, the public access directory of the industry 'Aqua', and the snowballing technique[33] were used to complete the list of interviewees, which is included in Appendix A at the end of this thesis. The following table shows the number of interviews conducted by group of actor.

Table 4.1: Number of interviews conducted by group of actor

Actor		Number of interviews
Bureaucrats		6
Public Agencies, Programmes, Institutes, Councils and Services		11
Private Institutes, Foundations and Consortia		5
Interest Groups subdivided into	NGOs	4
	Associations	7
	Trades Unions	2
Government decision makers in this case senators and deputies		6
Producers Firms		9
Supplier Services subdivided into	Consultants	7
	Lawyers	3
	Laboratories and Veterinarians	4
	Transport and Product Process	4
Media		2
Universities		8
Banking Sector and Financial Advisors		4
Total of interviews		**82**

Source: Own elaboration based on fieldwork.

Among the interviewees were, for example, the person who reported the virus in 2007, the firm that reported the virus and was accused of introducing the virus in the country, the person who wrote the project law to modify the initial Fishing and Aquaculture Law (Law N°18892) that was discussed at Congress, the political head of the process of modification of the Law N°18892, the head of the Fishing Commission in the Chamber of Deputies at the Congress, the head of the Fishing Commission in the Senate at the Congress, dissidents of the process of design and implementation of policy responses to the crisis, presidents of

[33] The 'snowballing technique' refers to asking people who have already been interviewed to identify other people they know who fit the selection criteria in order for them to be interviewed (Ritchie, Lewes and Elam, 2003).

associations, chief executives of firms, and several authorities such as the Undersecretary of Fishing and Aquaculture. At the time the interviews were conducted some people were working in the consultancy sector, but when the crisis arose in the industry they were authorities or relevant people at that time; these people were interviewed as well.

The strategy to reach interviewees was standardised. It involved sending a letter explaining the scope and purpose of the research, the reason why the Chilean salmon industry was chosen for the research, what information was required from the interview, and why the interviewee was chosen. The letter was sent in a file attached to an email that had a summary of the letter in the email itself. This strategy was complemented by telephone contact.

The secondary sources that complement the primary information included qualitative and quantitative documents (Eisenhardt, 1989) of the Chilean salmon industry and the sanitary crisis at micro and macro levels (Jupp, 1996). The following table displays these types of documents and their sources.

Table 4.2: Sources of data and information

Documents	Qualitative	Quantitative
Macro level (government, bureaucrats and public institutions)	- Enacted laws (e.g. Law N°18892 and Law N°20434) - Sectoral regulations (e.g. sanitary and environmental) - Records of parliamentary processes - Annual Reports - Other reports	- Statistics (e.g. production, exports, salmon price, employees, salmon eggs import, use of antibiotics, foreign direct investment, research and development, industry share)
Micro level (firms, associations, NGOs, private institutes, universities, media)	- Annual Reports - Other Reports - Articles of the industry - Newspapers	- Statistics (e.g. production, exports, salmon price, employees, research and development, firm share)

Source: Own elaboration based on Eisenhardt (1989) and Jupp (1996).

In particular, the content of the enacted laws (e.g. Law N°18892 and Law N°20434) and records of hearings of parliamentary proceedings with regard to passage of these laws were important sources of information. Also, the histories of those laws[34] (Law N°18892 and Law N°20434) provided valuable data for analysing what was defined as problematic, explanations of policy problems, and alternatives to solve them. They were also useful for examining the negotiation process and points of view following the actors and the discussions at parliamentary level.

[34] The history of the Law N° 20434 records the process of modification Law N° 18892 at parliamentary level. Laws and their histories are public documents which can be accessed from the Chilean Congress Library website www.bcn.cl.

4.7. Data and information collection

This research collected primary and secondary data and information. The aims of the study, in addition to the research questions and theoretical framework, guided the data collection. The primary data was collected in a single episode of fieldwork from April to July 2011, using a standardised method in order to gather information that could be compared across the sample (Wilson, 1996). This method involved a standardised open ended interview and a standardised interview schedule.

The standardised open ended interview was chosen as the gathering instrument because it gave the required flexibility to obtain more considered responses on the phenomenon, and it therefore provided better access to the opinions, views, interpretations, understandings and experiences of interviewees. Also it was the best way to explore the voices and experiences of key actors, for example, those actors who were misrepresented in the process of modification of law as part of the policy responses to the crisis (Byrne, 2004 cited in Silverman 1996, p.114). As the interviewees were key actors, and they also experienced the events discussed in the interview, their responses were more reliable.

The standardised interview included 20 open ended questions. All the questions were about real rather than hypothetical events. Of those 20 questions, 15 were in the foreground of the research and 5 questions were in the background of the research. Also, 13 out of those 20 questions were retrospective questions that referred to the causes of the sanitary crisis in the industry and the process of policy response, whilst the other 8 were focused on the, at that time, ongoing process of the early stages of the delivery of policy responses and their consequences.

The purpose of the interview was to gather information about:

1. Failures in the industry, causes of the crisis, and the context and sector in which the industry is embedded were developed (e.g. why previous regulations could not solve the disaster and how the process of policy response began).

2. The process of policy responses to the crisis (e.g. what were the signals that put the crisis in evidence, how the crisis became a policy problem, what were the models that inspired the policy responses, and whether scientific advice was used).

3. Early stage of the delivery of policy responses and their consequences (e.g. what were the difficulties of implementing or complying with the policy responses, whether policy

responses were facilitating actors' activities, whether actors had sufficient resources to comply with the policy responses, and whether there was compatibility between actors' interests and the goals of the policy responses).

Of the 82 interviews conducted, 81 were recorded and later fully transcribed. To ensure the reliability of the transcriptions they were done without any editing. The length of the interviews was between 30 minutes and two and a half hours, with an average of one hour.

The geographical distribution of interviews was: 31 were in Santiago (capital city), 38 were in Puerto Montt (637 miles from Santiago), 11 were in Valparaíso (73 miles from Santiago), 1 was in Puerto Varas (14 miles from Puerto Montt), and 1 was in Castro, Chiloé Island (108 miles from Puerto Montt).

<u>Santiago</u>:
- Bureaucrats (1)
- Public Agencies, Programmes, Institutes, Councilsand Services (5)
- Private Institutes, Foundations and Consortia (3)
- NGOs (4)
- Producers Firms (3)
- Consultants (3)
- Lawyers (2)
- Media (1)
- Universities (5)
- Banking Sector and Financial Advisors (4)

<u>Valparaíso</u>:
- Bureaucrats (3)
- Associations (1)
- Government decision makers (6)
- Consultants (1)

<u>Puerto Montt</u>:
- Bureaucrats (2)
- Public Agencies, Programmes, Institutes, Councilsand Services (6)
- Private Institutes, Foundations and Consortia (2)
- Associations (5)
- Trade Unions (2)
- Producers Firms (6)
- Consultants (2)
- Lawyers (1)
- Laboratories and Veterinarians (4)
- Transport and Product Process (4)
- Media (1)
- Universities (3)

<u>Puerto Varas</u>:
- Consultants (1)

<u>Chiloé Island (in Spanish 'Isla de Chiloé')</u>:
- Associations (1)

Figure 4.3: Map of Chile indicating the distribution of interviews (number of interviews in brackets)

The standardised interview schedule included (Wilson, 1996):

- All the interviews were conducted in person by the researcher.

- The same way of introducing the research and same format of approaching the interviewees was used.

- The same questions were asked of every respondent using the same wording: this helped to reduce ambiguity in the understanding of questions by interviewees. For the reliability of the interview and validity of the research it was important that every interviewee understood the questions in the same way as it was intended because this ensured obtaining responses on the topics to be investigated, and increased the certainty of coding the responses later and analysing the data.

- Notes were taken during the interviews.

The reliability of the interview schedule included a pre-testing from which the interview schedule and the version of the interview applied in the fieldwork were amended (Silverman, 2006).

The secondary data was collected longitudinally (more than one episode of data collection) from public access websites of different governmental and private organisations (see Table 4.2 for details of secondary sources). Also, several documents were collected by the researcher from some organisations during the fieldwork.

To ensure validity in the data collection, triangulation by data source and triangulation by method of collection were used (Eisenhardt, 1989; Mabry, 2008). Primary data was collected from different interviewees and complemented with secondary sources. Also, secondary data was collected from different organisations. Finally, data collected by first and second sources were cross-checked. In primary data the content of the interviews among different actors were checked in order to confirm, elaborate or disconfirm information from other sources and perspectives among actors. This helped to increase the level of accuracy in the data.

4.8. Data and information analysis

The research used a preliminary analytic strategy that led to two general strategies to analyse the data and information. Once those general strategies were applied, four complementary analytical techniques were employed to support the findings and draw conclusions.

The preliminary analytical strategy involved the construction of some categories and sub-categories where data and information were placed. Also data and information were put in a chronological order (Miles and Huberman, 1994). The constructed categories, sub-categories and the defined temporal scheme followed the three phases of the methodology. Thus, data and information were placed into the categories of: i) causes of the crisis, ii) policy response to the crisis, and iii) consequences of policy response to the crisis. Sub-categories for each category were defined to organise the data in order to distinguish and simplify background and foreground information. For example, into the category of 'causes of the crisis', a sub-category called 'institutional failure' was constructed. Data and information related to the factors located in the initial regulatory framework that contributed to the conditions that stimulated the crisis in the industry (e.g. regulations prior to the crisis did not specify and therefore enforce a maximum fish density per cage) were placed in this sub-category. The defined temporal scheme helped to clarify causal relations among the key concepts to be operationalised in the research (i.e. policy learning, changes in policy goals, changes in policy instruments, changes in the settings of policy instruments).

The two general strategies that were guided by the preliminary strategy were, i) to position the data and information analysis on theoretical propositions, and ii) to examine rival explanations (Yin, 2009). Data analysis followed the theoretical propositions that drove the research questions and defined rival hypotheses. Also rival theories were considered to explain the data and information in order to prevent bias.

The four complementary analytical techniques used to support the findings and draw conclusions were, i) explanation building (Yin, 2009), ii) time-series analysis, particularly the construction of a chronology (Yin, 2009), iii) constant comparative method (Lewes and Ritchie, 2003; Silverman, 2006), and iv) deviant case analysis (Lewes and Ritchie, 2003; Silverman, 2006).

Explanation building was used since the aim of the research is to explain the phenomenon of policy response to the sanitary crisis faced by the Chilean salmon industry between 2007 and 2010. Therefore causal links between policy responses and the sanitary crisis were made. Also, the Chilean salmon industry is considered as a successful industry, which, in a short period, became the second largest producer and exporter of farmed salmon at the global level. The industry was affected by a virus whose existence was known about by the Chilean industry since other salmon producers and exporters at the global level experienced this crisis before Chile (e.g. Norway in 1984, Canada in 1996, Scotland in 1998, Faroe Islands in 1999, and the United States in 2000). This situation deserves an explanation that may include what lessons the Chilean industry failed to learn from its competitors, but, more importantly, what is the importance of anticipating crisis at the industry level.

The chronology was used as an analytical technique since the research is a longitudinal study and examines concepts such as policy learning and policy change over time. Also because some events occurred before others, the ordering of those events over time enlightens the construction of causal relationships among them. The time that the empirical context covered was since 2007, which is the year of the onset of the sanitary crisis in the industry, up to 2013, which is four years after the publication of the new Law of Fishing and Aquaculture (Law N°20434), and allows the observation of consequences of the policy responses to the crisis.

The constant comparative method and deviant case analysis were used as techniques to analyse the data but also to reach internal validity. The former was a way of checking 'accuracy of fit' by developing hypotheses in one part of the data and testing them in other parts of the data, comparing, for example, the responses among actors (e.g. Atlantic salmon producers versus Coho salmon producers, producers versus NGOs, bureaucrats versus producers). The latter was a way of including all the cases, especially the outliers in the analysis without ignoring or forcing them into the categories. For example, it was crucial in this research to analyse why and when Coho salmon producers started to draw apart from the Association of Chilean Salmon Industry (since at the beginning of the design of policy responses they agreed with the Association about the need to modify the General Law of Fishing and Aquaculture), what are the characteristics of Coho salmon producers, whether there are differences between Coho salmon producers and other types of producers, and whether these differences influenced their policy options.

Since the research used a platform of opinions, interpretations and understandings by interviewees as evidence to answer the research questions, triangulation by data sources and contents and triangulation by method of data collection were used to verify and support those opinions, interpretations and understandings. Also theoretical triangulation was used to explain and analyse the data (Mabry, 2008).

4.9. Synthesis of the chapter

This research employed the policy response to the sanitary crisis of the Chilean salmon farming industry as the case study. This case study was identified as a suitable case to analyse and test the framework on policy learning and policy change stimulated by catastrophic events. The selection of the case study was a combination of an interest to learn and contribute empirically to a deep understanding of policy responses to the sanitary crisis of the Chilean industry, and an interest to extend the policy learning and policy change literature in the context of crisis. The case study was used as the research method because it was found to be a more explanatory approach to the study; the researcher could not control the conditions of the study, and the study was a contemporary phenomenon to which the researcher had direct access through participants involved in the crisis.

The research strategy to operationalise the theoretical framework and answer the research questions involved three phases. The first phase conducted a characterisation and diagnosis of the Chilean salmon industry using an adaptation of the system failure approach and causal stories. The second phase analysed the policy responses to the crisis using a policy learning and policy change approach. The third phase analysed the consequences of the policy responses to the crisis from a conflict and ambiguity perspective. In those phases policy learning in a context of industry crisis was the dependent variable, and how policies changed over time were used as the explanatory variables to understand the institutional change in the Chilean industry.

The research employed primary and secondary sources of data and information. The primary source data was gathered from a complete set of industry actors in a single episode of fieldwork using a standardised open ended interview and a standardised interview schedule. The actors interviewed were selected through a purposive sample driven by the research questions and the theoretical framework. The secondary sources included qualitative and quantitative documents and were collected longitudinally from public access websites of different organisations and by the researcher during fieldwork. To ensure validity in the data collection, triangulation by data source, contents and triangulation by method of collection were used.

To analyse the data and information, the research used several analytical strategies. A preliminary strategy was to construct categories and sub-categories where data and information were put in chronological order. Then the data was analysed following the theoretical propositions and considering rival theories. Furthermore, explanation building was used to enlighten the policy response in the industry, and causal links between policy responses and the sanitary crisis were made. A chronology was used because the research is a longitudinal study. The ordering of events over time enlightened the construction of causal relationships among them, and concepts such as policy learning and policy change were examined over time.

The constant comparative method and deviant case analysis were used not only as analytical techniques but also to reach internal validity. The former was a way of checking 'accuracy of fit' by developing hypotheses in one part of the data and testing them in other parts of the data. The latter was a way of including all the cases, especially the outliers in the analysis without ignoring or forcing them into the categories. Theoretical triangulation was used to explain and analyse the data.

To satisfy reliability, this research explained the research strategy and data analysis and made the theoretical lens employed to interpret the data and findings explicit. Moreover, it explained how the chosen theoretical lens allowed those interpretations. To ensure validity, the research was constructed by measuring the policy response to the sanitary crisis through a policy learning and policy change lens in terms of changes in policy goals, policy instruments and the settings of policy instruments. Internal validity was achieved through causal relationships in the data and the analytical tactics explained in the above paragraphs. External validity was achieved by explaining the generalisation of the findings. In that regard, this chapter pointed out that it is incorrect to conclude that it is not possible to generalise from an individual case, or to conclude that a single case study cannot contribute to scientific development. The generalisation from this research is possible but limited because the policy response to the sanitary crisis in the Chilean salmon farming industry is not free from idiosyncratic features. However, the conclusions drawn from this thesis offer a potential opportunity for further research and in this sense contributes to the advance of knowledge.

CHAPTER 5

CAUSES OF THE SANITARY CRISIS IN THE CHILEAN SALMON FARMING INDUSTRY

"[The sanitary crisis] actually was a chronicle of a death foretold"
(An interviewed Service Supplier)

This chapter analyses the nature of the sanitary crisis in the Chilean salmon farming industry that occurred in 2007, and how it helped to inform and defined industry policy problems due to ISA. It also examines how the sanitary crisis became the policy window for radical policy change, particularly in reforming the industry regulatory framework, and precipitated the industry policy learning and policy change.

This research considers the period of the sanitary crisis between June 2007 (index case) and December 2010, when there was a dramatic drop in the virulent ISAv cases. It is arguable that the conditions that stimulated the sanitary crisis provoked a system failure in the industry, and therefore the explanations about causes of the crisis are organised and analysed using a system failure approach. Particular emphasis is put on the hard institutional failure experienced by the industry, since it can be demonstrated that the initial industrial regulatory framework prior to the crisis was not designed to protect the industry from the crisis. In addition, it was not adequately implemented, even when the industry and government were aware about ISA sanitary crises in other global salmon producer countries such as Norway.

5.1. Causes of the sanitary crisis in the Chilean industry as the basis for policy responses

Following Kingdon's (2003) concept of indicators, and Deutsch's (1966) concept of feedback to government, long before the sanitary crisis occurred in the Chilean salmon industry, different actors were providing indicators and feedback about the critical sanitary and environmental situation of the industry to government officials including policy makers. Critiques made in the forms of studies, reports, research and news from environmental and labour NGOs (e.g. Environmental and Labour Monitoring of Chiloé, OCEANA, Terram, ECOCEANOS), artisanal fisherman (e.g. CONAPACH), universities (e.g. Universidad de Los Lagos and its institute i-mar, Universidad Arturo Prat, Universidad Austral), public and private institutes (e.g. National Centre for Alternative Development Studies, Libertad y Desarrollo), the national media (e.g. Technopress with its electronic bulletin aqua.cl; local newspapers such as La Tercera, El

Mercurio, El Mostrador, Diario Estrategia) and international media (e.g. New York Times) to name a few, were well known and publicly accessible. These indicators and feedback provided information in the areas of fish disease, intensive production model of the industry, use of antibiotics, environmental impacts from salmon production, water pollution, salmon escapes, salmon feed, and other topics. NGOs were also alerting the state about the lack of regulation in the sector and industry, and the serious consequences it could have for the environment.

In July 2006 (a year before of the onset of the sanitary crisis) an Inquiry Commission, established by the Committee on Fisheries, Aquaculture and Marine Interests of the Congress, investigated the labour and environmental impacts of the salmon industry. Its published report provided crucial evidence regarding the unsustainability of the industry model at that point in time, and included information on sectoral regulations and industry practices (Chilean National Congress Library, 2006c). An interviewed policy maker who participated in this Inquiry Commission pointed out that issues such as concession densities, the non-establishment of health management areas, non-fallowing and overproduction were for them, at that moment, a clear indication that an epidemic was likely.

More directly, even the salmon and the sea lice caligus were providing feedback that was observable in the industry. An interviewed Consultant explained that since smolt with compromised immunological quality started to be placed into the water, harvesting times were longer, fish growth rates were lower, and morbidity and feed conversion rates[35]were higher.

As noted earlier in Section 3.2 (Chapter 3), the productivity of the industry, particularly since 2004, was declining. At the end of 2006 and beginning of 2007, the observed caligus population increased five times over earlier levels, which clearly indicated that the fish were less healthy in general and therefore most likely also had impaired immune systems (An Interviewed Consultant). This information constituted signals of how poorly the industry was performing in sanitary and environmental terms, and even more it was an early warning of a coming sanitary catastrophe. However, all this feedback was not seen as a signal of a coming crisis requiring urgent transformation of the critical sanitary and environmental situation of the industry involving its intensive production model, or as a problem to be faced by policy makers and government officials (in Kingdon’s term, a policy problem).

[35] The Feed Conversion Ratio (FCR) corresponds to the total feed given divided by the total weight gain (Tacon, 2005).

When the ISAv was introduced into the country, it caused massive salmon morbidity. The magnitude of salmon fatalities and the infestation of farms across the industry was feedback that could not be ignored by the sanitary authority, Sernapesca, and other government officials. It did not take long before the crisis was defined as a policy problem and given high priority in the governmental agenda. Kingdon (2003) conceptualised these types of events as 'focusing events'. They are short shocks that attract the attention of individuals in and around the government, and government officials decide to do something. The sanitary crisis in the Chilean industry was a focusing event.

In this way the sanitary crisis itself, that is, to stop the epizootic infestation and reduce the fish mortality due to ISAv and control the spread of the virus and the disease, became the first defined policy problem (Chilean National Congress Library, 2010d). The policy subsystem (Sabatier, 1988) involved in the definition of the sanitary crisis as a policy problem was the producer firms, the Association of Salmon Industry (SalmonChile), the government by its sanitary authority (Sernapesca), and international laboratories, which confirmed that the pathogen was actually the ISAv. The measures for this, however, remained to be determined.

Since the response to the crisis depended upon an understanding of its causes, it is important to examine the variety of explanations available as policymakers began to consider a response. Primary data gathered in extensive fieldwork reveals that the sanitary crisis in the Chilean salmon farming industry could not be assigned to just one direct cause. Instead, there were many interdependent failures that, in retrospect, can be seen as having led the industry to the crisis.

Following the ecological system failure framework formulated in Chapter 2, a list and brief explanation of each failure reported by the complete set of industry actors interviewed during fieldwork is given below. Since the fieldwork occurred well after the onset of the crisis these reported failures have the benefit of hindsight – they are, to some extent, retrospective views even though respondents were asked to recall what explanations were offered at the time of the crisis. They are categorised in institutional (hard and soft), infrastructural, interaction (weak and strong), capabilities and unexpected failures. As discussed in Chapter 2 the unexpected failures category was added because this is critical for natural resource based industries such as salmon farming.

Table 5.1: System failure and narratives

NARRATIVE			N2	N8	N3	N9	N1	N4	N5	N6	N7	N10
			Negligence of the industry in fattening up salmon	Caligus	Negligence of the industry in contaminating the water	Natural conditions	Ignorance of the industry	Exacerbated desire to maximise profits	Blinded by economic success	Self-regulation	Permissive regulation	Industrial sabotage
FAILURES												
Institutional	**Hard**	Lack of and lag in regulation		X							X	
		Profligate granting of concessions						X			X	
		Ineffective enforcement system									X	
		Lack of risk assessment				X					X	
	Soft	Free production approach – framework of the regulation								X	X	
		Scope of the role of the state							X	X	X	
		Short term vision	X				X				X	
		Concealment of information	X									
		Overconfidence/arrogance of the industry						X				
		Ambition					X	X		X		
		Reactive approach and behaviour		X			X				X	
Infrastructural		Lack of capacity of the sanitary authority								X	X	
		High concentration of farming centres– intensive production model		X								
Interaction	**Weak**	Lack of scientific knowledge to make production decisions				X	X					
		Individualistic approach to perform aquaculture/salmon activities			X						X	
	Strong	Collusion						X				
Capabilities		High concentration of fish per cage (high density) – intensive production model	X	X	X			X				
		Lack of fallow– intensive production model			X							
		Heavy use of medical inputs – intensive production model	X				X				X	
		Smolt with compromised immunological system	X					X				
		Presence of other pathogens	X	X		X						
		Ignorance				X	X					
		Capability of the sanitary authority (including lack of resources)								X	X	X
Unexpected		Attempt										X
		Natural conditions		X		X						

Source: Own elaboration based on analysis and ecological system failure approach.

The above table illustrates how the diversity of industry failures created divergent narratives which explain the causes of the sanitary crisis, as explained below.

Institutional Failures:

Applying Woolthuis, Lankhuizen and Gilsing's (2005) concept of institutional failures to the Chilean salmon industry, they refer to the 'rules of the game' in which the industry operates regulating actors' behaviour and their interaction. These rules of the game are part of the industry regulatory framework.

Following the definition of *hard institutional failures* posed by Woolthuis, Lankhuizen and Gilsing (2005), in the Chilean industry they refer to the formal mechanisms in the industry regulatory framework such as laws and regulations.

- F1: *Lack of and lag in regulation*. This refers to the late development of an environmental and sanitary regulatory framework for the industry. The regulatory framework of the aquaculture sector, and therefore of the industry, formally began in the late 1980s with the 1989 General Law of Fishing and Aquaculture (Law N°18892) (see Appendix B for a history of the industry's regulatory framework). However, the environmental and sanitary regulations came in the 2000s with the 2001 Decree N°320, which set the Environmental Regulation RAMA (for its Spanish acronym), and 2002 Decree N°319 which set the Sanitary Regulation RESA (for its Spanish acronym).

- F2: *Profligate granting of concessions.* The scheme for allocation of concession resulted in an excessive delivery of them[36].

- F3: *Ineffective enforcement system.* The system was unable to persuade and induce compliance with environmental and sanitary conditions required by regulations.

- F4: *Lack of risk assessment* to protect the industry from exotic diseases such as ISA, reduce the negative externalities to the environment, reduce the risks related to the operation of the industry, and ensure a sustainable production.

[36] An aquaculture concession is the administrative act by which the National Ministry of Defence gives a person the rights of use on certain domestic goods and the person should perform aquaculture activities (Chilean National Congress Library, 1989).

In the Chilean salmon industry there are implicit rules of the game in which the industry operates, such as beliefs and values that shape policy and policy environments. This is what Woolthuis, Lankhuizen and Gilsing (2005) refer to as *soft institutional failures.*

- F5: *Free production approach – framework of the regulation*. Concessions were granted without reference to the level of production they allowed or when they might be terminated. Implicitly this allowed unlimited production for an unlimited time.
- F6: *Scope of the role of the state*. The state allowed inadequate practices in the industry despite evidence of environmental harm from these practices.
- F7: *Short term vision*. Although there has been a National Aquaculture Policy since 2003, there was no strategic plan for the industry. There was no process for defining a sustainable policy to develop the aquaculture sector or salmon industry, and no plan for preventing or protecting the aquaculture sector and the salmon industry from diseases.
- F8: *Concealment of information* to hide the poor performance of the industry.
- F9: *Overconfidence/arrogance of the industry* given the golden period the industry was enjoying when the crisis came due to its economic profits, excellent technological development, and the social development the industry gave to the southern regions in the country.
- F10: *Ambition* to reach one million tonnes of salmon species, to catch up with the Norwegian production and achieve higher levels of profit.
- F11: *Reactive approach and behaviour*. This refers to the reactive rather than preventive approach of the regulatory framework. Regulations and modifications to regulations came after the industry experienced difficulties or crises such as the ISA crisis, after which the 1989 General Law of Fishing and Aquaculture (Law N°18892) was modified creating the 2010 General Law of Fishing and Aquaculture (Law N°20434).

Infrastructural Failures:

Although Woolthuis, Lankhuizen and Gilsing (2005) refer to innovation, their concept of infrastructural failure discussed can be applied to the Chilean salmon industry. In that case, they refer to the physical systems that are necessary for the operation and development of the industry.

- F12: *Lack of capacity of the sanitary authority* to control the industry.
- F13: *High concentration of farming centres – intensive production model*. Concentration of farming centres into concessions, and high concentration of concessions in areas.

Interaction Failures:

Following Woolthuis, Lankhuizen and Gilsing (2005) discussion on weak and strong interaction failures, we say that, in the context of the salmon industry in Chile, interaction failures may be defined as the interactions among actors of the industry and the sector in which the industry is embedded. *Weak interaction failure* corresponds to a poor connectivity among actors that prevents synergies and learning, whilst *strong interaction failure* corresponds to dominance dependence among actors who may be locked into 'inadequate' practices.

Weak interaction failures:

- F14: *Lack of scientific knowledge to make production decisions* given the disconnection between the industry and the knowledge providers (e.g. universities, research centres).
- F15: *Individualistic approach to perform aquaculture/salmon activities* that do not take into account collaboration and coordination among producers to look after and manage the common-pool resource water and the industry as a whole.

Strong interaction failures:

- F16: *Collusion between the producers and providers of the Environmental Reports* (INFAs by its acronym in Spanish) that are the point of reference to report environmental impacts from the production of salmon. Prior to the crisis producers were responsible for the production of these reports and hired a third party to perform the studies. When the outcomes of these reports were too negative and there was a danger of the continuity of production being disrupted, the producers asked that the results of the studies were changed in order to show positive impacts.

Capabilities Failures:

Lack of competencies, capacities and resources is what Woolthuis, Lankhuizen and Gilsing (2005) conceptualised as capabilities failures. Capabilities failures in the salmon industry may refer to the lack of competencies, capacities and resources toward an unsustainable development.

- F17: *High concentration of fish per cage (high density) – intensive production model*. This is the overcrowding of fish in farming cages.
- F18: *Lack of fallow– intensive production model* that ensures continuous production without renewal of the common-pool resource water to preserve its quality.
- F19: *Heavy use of medical inputs – intensive production model* such as antibiotics, fungicides and vaccines to deal with lower productivity and maintain competitiveness.
- F20: *Smolt with compromised immunological system* that makes the fish weak and more susceptible to pathogens and diseases.
- F21: *Presence of other pathogens* that act as carriers, vectors or reservoirs of ISAv, such as the sea louse caligus.
- F22: *Ignorance* about basic variables of the system such as salmon biology and the direction of ocean currents.
- F23: *Capability of the sanitary authority (including lack of resources)* in detecting and recognising ISA. Prior to the crisis no system was developed and ready for this particular purpose. It includes lack of personnel to monitor and control environmental and sanitary industry practices by the National Fishing Service.

Unexpected Failures:

The aquaculture sector, in general, and salmon industry in particular, face and deal with significant uncertainties. These uncertainties come from nature (i.e. unexpected factors such as natural conditions and natural disasters) and from the activities themselves (i.e. inherent uncertainties). These uncertainties can lead to unexpected failures, either because of their appearance or because of the decisions that are made to deal with them.

Even when natural conditions or circumstances and inherent uncertainties are not taken into account in the strategy and operations of an innovation system, the failure framework, including unexpected failures as discussed in Chapter 2, is pertinent for two reasons. The first is that, since the industry is embedded in an ecological system and works with a biological 'delicate' resource (i.e. salmon), it is always relevant to include the inherent uncertainties related to fish responses in the way in which the resource is treated. For example, fish response to antibiotics or other disease treatments, change in diet, vaccines, and vaccination methods to name a few, and natural conditions (expected and unexpected) such as water with less oxygen, water with more nutrients, and higher or lower temperatures.

This research recognises that these uncertainties, as well as natural conditions or circumstances and natural disasters, may play a role in sanitary crises such as the ISA crisis. Other inherent uncertainties related to salmon production are the long production cycle[37], attacks of salmon cages from South American sea lions (Otaria flavescens) that produce salmon mortalities, salmon escape and increase in fish stress, and salmon theft.

The second reason is that natural conditions or circumstances can be considered as acts of God[38], such as those discussed by Sidmon (1923) and Bozeman (1952), and it can be believed that sanitary crises like that of ISA may be such an event. However, as Wijkman and Timberlake (1984) argue, humans may play a key role in making their environment more prone to certain crises.

This research demonstrates that the sanitary crisis faced by the Chilean industry was not an act of God but an act of man. At the same time it recognises the natural conditions the industry faced at the time of the crisis and that those conditions, to a lesser extent, also played a role. Among these natural conditions are the geography of Chile, which played a role in spreading the virus, and the weather at the time of the crisis.

One of the natural disasters that affected the industry during the first year of the ISA crisis was the eruption of Chaitén Volcano (X Region), which started on 2 May 2008. As a consequence of this, eight farming centres infected with ISAv were isolated. To avoid an ecological disaster from fish mortalities, Sernapesca authorised the move of those centres to another area in the

[37] This is different for Atlantic salmon, Coho salmon and trout. The longest production cycle is for Atlantic salmon, which is between 27 and 33 months.

[38] 'Any accident, due directly and exclusively to natural causes without human intervention, which by no amount of foresight, pains, or care, reasonable to be expected, could have been prevented' (Bozeman, 1952, p.422).

region –Quellón. This action resulted in the spread of the virus and the infestation of other farming centres (La Tercera. com, 2009, Sernapesca, 2008a).

The eruption of Chaitén Volcano and its consequences is just one example of natural disasters that have affected the Chilean salmon industry. Other more recent disasters that have affected the industry are: earthquake in Aysén Fjord (April 2007), earthquake in the Bío-Bío Region and subsequent tsunami (February 2010), tsunami warning for earthquake in Japan (March 2011), and Cordón Caulle eruption (June 2011) (Mundo Acuícola, 2013).

Other environmental factors that may affect the industry are storms and algal blooms[39]. For example, in March 2009 a harmful algal bloom[40] of Alexandrium catenella was observed in the Aysén Region. Reported by Aqua, it produced significant mortalities in Atlantic salmon (Aqua.cl, 2009b) and, according to Diario Financiero, an economic loss of more than US$10 million to salmon producers (Diario Financiero.cl, 2009).

- F24: *Attempt* to reduce the comparative advantage of the Chilean industry and its position at the global level (i.e. competitiveness of the industry).
- F25: *Natural conditions* that allowed the reproduction of ISAv such as dry year, higher temperatures, more salinity of the sea and the geography of Chile.

The interdependence of these 25 failures, and interaction among different actors and institutions, are demonstrated through the following 10 causal stories that explain why the Chilean industry had a sanitary crisis. These stories were composed from the failures and story lines reported by the interviewed actors, and organised in the causal stories framework developed by Stone (1989).

Inadvertent cause:

Following Stone's framework on causal stories in policy making (Stone, 1989), we argue that some of the explanations given by the interviewees about why the Chilean industry had a sanitary crisis may be interpreted as inadvertent causes. The explanation of these causal

[39] 'The rapid excessive growth of algae, generally caused by high nutrient levels and favourable conditions. Can result in deoxygenation of the water mass when the algae die, leading to the death of aquatic flora and fauna' (http://www.greenfacts.org/glossary/abc/algal-bloom.htm Last accessed: 22 January 2013).

[40] 'Algal bloom events involving toxic or otherwise harmful phytoplankton. Such blooms often take on a red or brown hue and are known colloquially as red tides' (http://en.wikipedia.org/wiki/Algal_bloom Last accessed: 22 January 2013).

theories refer to purposeful actions of the industry that had unexpected negative consequences.

Narrative 1: Ignorance of the industry

The industry did not know that the manner in which the salmon was being cultivated was causing, or could cause, negative externalities to the environment and other actors (lack of knowledge). According to an interviewed producer firm, the cultivation focused on growing and producing salmon, and not on knowing how the biological resource salmon and the environment in which the salmon was growing up operated (short vision). He explained that there were basic things that the industry did not know, such as the characteristics of the salmon and the environment in which the salmon was being cultivated (e.g. direction of the currents, operation of circuit nutrients, levels of oxygen). This point was noted by the interviewee when he said '…I perfectly remember saying to an oceanographer… …we have cages in the sea, in different points, at different depths and we really had no idea how the currents worked in the sea, if we had oxygen or not, how that condition affected the fish…that means that there was a profound ignorance of many things that were critical, today we know they are critical, but at that moment we did not know that…'.

For this reason the industry addressed the consequences of problems rather than their causes (reactive behaviour). For example, if the salmon was sick the industry used medicines to make the salmon better rather than try to understand the reasons for the salmons' illness. If there was an algal bloom the industry put oxygen in the water rather than try to understand the reasons for that algal bloom and know whether the salmon was being located in a right place for maturation. Regarding this, the interviewee observed '…probably we attacked the consequences...nowadays there is a study of a matrix of risks and impacts analysis. Nowadays I locate a centre to fifteen feet deep or thirty and I know I am surrounded by this or that thing, that the currents come here, etc., that is, there is a much deeper analysis…'.

Another issue, he continued, was that the lack of knowledge in biological and environmental resources was due to a disconnection between the industry and the knowledge providers such as universities and research centres. This lack of knowledge was also due to a deficiency of professionals connected with marine sciences. There was a lack of information and knowledge in critical aspects (such as the introduction of pathogens via the import of eggs) and from the field (i.e. what was going on with the fish). A representative of an Association described by in the following way, '…the industry started to be fed with professionals, perhaps...there were marine biologists, fishery engineers, veterinarians, but the veterinarian somehow, was educated to creatures that live on land, not in the water, then, there was a sort of metamorphosis that never worked and the result was a shortage of professionals. On the other hand, the entrance of industrial civil engineers began, commercial engineers, they put pressure on the productive part, they saw no more than costs, the biological part, the part of the salmon, the animal welfare and a lot of factors that are seen on the field itself…no, that was not an issue for them because that was not their responsibility, and from there the productive chain of the industry began to weaken…'.

Probably the ambition of the industry in maximising profits was part of this ignorance. Shareholders and managers of firms were focused only on maximising production and minimising costs. Regarding this, a representative from an Association noted 'it was sought to maximize the production but without knowing if that was feasible in reality or if that was known it was ignored or it wanted to believe that what happened was not going to happen, which in our opinion was a foretold chronic'. In the same line, an interviewee linked to the industry from the service sector said that the role of the veterinarian was ignored and the role of managers was privileged; because of this, the salmon production was based only on profitability without taking into account the environment and animal welfare, and this led the industry to unsustainable practices in production.

Narrative 2: Negligence of the industry in fattening up salmon

Opinion was shared across the interviewees that the industry was operating with a great biomass per cage (i.e. high concentration of fish per cage), and that the industry had an inclination to use immunologically weak smolt to produce salmon. Smolts such as these are very susceptible to die and/or get pathogens and diseases. Regarding this, an interviewed Consultant said '…if you do not respect the production of an animal…with enough space, with a good immune system, it will get diseases. If you do not respect that it is likely that disease will come and also if this is an exotic disease in a place where you have many farming centres, this is, there is a more or less intense production and also you do not have certain biosanitary measures…'. Another interviewed consultant pointed out that this practice constitutes a sanitary risk known to the industry. He explained that immunologically weak smolts were being forced to finish their production cycle in order to meet the requirements of the market, and in order to accomplish this objective the industry was using high levels of medical inputs such as antibiotics and fungicides. This point was described by the Consultant when he said 'such was the growth in the industry and such was the demand of an end product to different markets that the firms discriminated little about the quality of their smolts that had to be placed in the sea, because they needed more smolts placed in the water…then dramatic things began to happen; the harvest times were longer, growth rates were obviously lower, morbidity rates were higher, feed conversions were increasingly high, and therefore more food was demanded per produced kilo. All this made from the point of view of productivity that the situation went from bad to worse, but the goal was to meet with clients who demanded a certain amount of products in those years'. An interviewed NGO said that the number of mortalities and the quantity of medical inputs was not public information. The interviewee observed '…we knew that the industry was abusing antibiotics, although the government never released the information on the use of antibiotics until we requested it in 2009. We knew that, for example, in 2007 the salmon industry in Chile used 385 tons of antibiotics. That year Norway used 600 kilos, and that is the point, Norway used 600 times less antibiotics than Chile, with a higher production…'. There was agreement among the interviewees that, at the time of the sanitary crisis, the industry was operating with its highest level of caligus, a vector for ISAv. As narrative 8 explains.

Narrative 3: Negligence of the industry in contaminating the water

The industry was operating with a great biomass (i.e. fish in the water) and without fallow periods. An interviewed researcher from a University explained that the more fish there were in the water, the more pollution to the water from the uncaptured feed and faeces; this implies an accumulation of contaminating material on the seabed, and negative impacts on the biodiversity and other water users. Poor quality of water due to the accumulation of contaminating material constitutes a stress for the salmon making it immunologically weaker. Since the water is a common-pool resource and farming centres are close to each other, the contamination in one farming centre may affect other farming centres. Regarding this, an interviewed producer firm observed '…unlike the production in other environments, as might be in land, in the sea the externalities are huge, that is, it is not enough that I do well, I have to do it well and you have to do it well and the neighbour has to do it well, otherwise, due to the currents in Chile, all of us end badly'. The lack of fallow does not allow the renewal of the water and its improvement in terms of quality (e.g. oxygen). Several individuals often mentioned this. For example, a representative from an Association described this in the following way, '…there are farming centres that took responsibility for fallowing…there are farming centres that never fallow in the 20 years'.

To clarify the claim posed above, we use the explanations made by Buschmann (2006) and Pizarro and Zolezzi (2003). According to these authors water pollution from salmon farming production comes mainly from uneaten feed, fish faeces and chemical treatments for salmon. Organic salmon wastes (feed and faeces) contribute with about 75% of phosphor, nitrogen and carbon to the aquatic environment. Just 25% of these elements are actually recouped when salmon is harvested (Buschmann, 2006). This is because about 25% of the given feed is eaten by the salmon and between 75-80% remains in the environment. Part of this 75-80% goes to the seabed and the other part remains in the water column. It has been estimated that more than 60% of the phosphor and 80% of the nitrogen from the organic salmon wastes remain in the water column. The increase in these nutrients (i.e. phosphor and nitrogen) in the water provokes a process called 'eutrophication' that decreases the level of oxygen and therefore reduces the biodiversity (Pizarro and Zolezzi, 2003). Phosphor is accumulated under the cages and is used as an indicator of water pollution (Buschmann, 2006).

Narrative 4: Exacerbated desire to maximise profits

Pointed out by some interviewed producer firms, although the industry was started through the initiative of the state (entrepreneurial state), the private sector played a crucial role in developing the industry and making it the second largest producer and exporter of salmon at the global level. An interviewed deputy stated that this made the industry feel an overwhelming success, which translated an arrogant and resistant attitude to be questioned and controlled by regulation. It was agreed across the interviewees that the industry was developed on the principle of self-regulation and with the belief that the state was unnecessary. This point can be exemplified by the words of an interviewed NGO who said '…they are [the private sector] who feel that they are the parents of the project of this industry. They indicate that this was a private initiative that emerged from their effort when they were small, when they were visionaries…and they believed this and therefore that was the main argument for the state to not regulate because they knew what the activity was…'.

An interviewed producer firm explained that since the production of salmon was a very attractive business, the industry started to ask increasingly for more concessions; a situation permitted by the legislation. The producer firm described this in the following way, '…this thing started badly because when many years ago this thing about concessions appeared, I could ask half of the Chilean Sea and nobody stopped me...and this at the end resulted in many people with vision became millionaires at the expense of demanding rights which were free and at expense of demanding rights by a map. Here there was not a process in which authorities said we are going to study this region and we will determine the 200 best places and we will visit them...no, here it was, look, here is the table, the law is the law, who grabs, grabs, and then they grabbed the maps and started asking for concessions with a map and with not serious studies that any individual could support…'. The industry was overambitious and engaged in relentless increases in production and profits, which ended in an unsustainable production model. A representative from the banking sector opined that the disproportionate ambition of the industry was translated into an abuse of natural resources. An interviewed researcher working in a University said that the ambition led the industry to use smolt of bad quality, increase the fish densities, buy salmon eggs from any supplier, and, finally, relax the complete process of producing salmon. There was a desire for rapidly growing the industry and everything was focussed on this avarice. In the same line and regarding this, an interviewed deputy said '…the arrogance of the managers and their greed for having returns that do not exist anywhere else in the world plus a timorous attitude of our past and current government officials especially in the labour and environmental fields in the previous government, obviously, that leads us to this kind of problems…'.

It was argued by an interviewee from a public agency that the ambition of the industry and its desire to maximise profits via continuous production, also pushed the industry to perform inadequate practices such as collusion between producers and environmental report providers to report positive impacts from the salmon activities, even when this was not and could not be the case. An interviewed researcher from a University argued that one of the consequences of wealthier salmon businesses was their physical distance from the places of production (since they went back to the capital city Santiago), and therefore emotional distance from the employees, communities and the environment. He observed '...not only their ego skyrocketed but they began to tell themselves stories of heroes, to follow each other and also to make an apology of the salmon cluster…'.

Narrative 5: Blinded by economic success

The salmon industry is an example of success to the Chilean politicians. They proudly present the industry abroad as an exemplary model of development and modernity that combines foreign investment, natural resources, workforce generation and export orientation; an industry that grew rapidly and became part of the global economy. A representative from an NGO said 'President Lagos said, leaving, because here all say when they leave... said, I leave and one of every three salmon consumed in the world comes from Chile, that is my cover letter that my management was successful because I was able to combine natural resources, international capital, technology, large companies and Chilean workforce'. Some NGOs pointed out that since the industry had a huge social and economic impact in the regions where the production takes place i.e., the generation of approximately 50,000 jobs in moribund regions and the development of supplier industries, the state became part of the objectives of the industry, ignoring the negative environmental and sanitary impacts that the industry was causing and privileging its economic success over other considerations. Another interviewed NGO said that the state gave the political support that the industry needed for unbounded growth. He said '…there was no interest from the Chilean government and the state in general to restrict and regulate properly this industry. The excessive growth of the industry was encouraged without taking measures for preventing this situation, the economic aspect was privileged and the environment was forgotten, the welfare of the population, of the local communities and the economic activities that already exist in Patagonia, and that was a deliberate strategy by the Chilean government'.

Narrative 6: Self-regulation

An interviewed bureaucrat from Subpesca explained that the self-regulation model in which the industry was developed played a key role in the fast growth of the industry. Probably without self-regulation the industry would not be what it is today. He continued, saying that the state did not have the capacity and capabilities to regulate the industry, and that, apparently, the industry had sufficient capabilities to self-regulate and take care of the business and the environment in which the business was operating. In his words, 'I personally was one who always defended the self-regulation because I thought that it is an industry that did not exist, it was a region that did not exist, that was nothing in 1985, 1986. From there it became the second largest producer and exporter, billions of dollars, it created thousands of jobs. It seemed to me that there was sufficient grey matter, business capacity to take care of that, but in the same way the industrialists were wrong, I was wrong too as an advocate of the industry, without having anything to do with them. The role of the state in regulation is critical…it is necessary to implement rules to these guys because if rules are not implemented the enthusiasm can end up killing…'. However, an interviewee from the banking sector pointed out that self-regulation did not work because it was translated into a disproportionate liberty, which favoured investments and profit maximisation over environmental and sanitary standards. A representative from a producer firm referred to the unworkable aspect of the self-regulation from a cultural point of view in the following way, '…our way of functioning and due to the culture we have, we do not have a concept of self-regulation. We necessarily depend on a regulatory framework to tell us at least in broad terms what are our limits. Our culture is not self-impose limits…'.

Self-regulation was a well-intended model in which the state believed, but it was demonstrated that it had unintended negative consequences; this was said by an interviewed producer firm. He pointed out that in self-regulation models the existence of free riders who create negative externalities was likely, and the Chilean salmon industry was not an exception. In open common-pool systems like the sea, the externalities are greater than in closed systems (e.g. land) where their effects are more evident and it may be easier to control them. It is clear that the role of the state is fundamental in providing control and rules of the game for natural resource based industries. In the same line, this point was also mentioned by an interviewed lawyer when he said 'the free riding meant a lack of control regarding sanitary management, a lot of high densities of fish, greater chance of infection, many movements of fish, the fish were more likely to become stressed and lower their immune system…what the crisis demonstrated is that the entire industry shares the same aqueous environment, and what happens in a part of the aqueous environment will have effects on the rest. Then, we must prevent that the free riding, in all types of environmental and sanitary behaviours, affect the rest…'.

The six narratives posed above argue that the development of the conditions that led the industry to the crisis were not intentional. Although there was a persistent pursuit of salmon output growth and profit, this was understood as a natural behaviour of investors who wanted to make the most from a good business opportunity. The co-facilitating state regulation and self-regulation were well intentioned actions to rapidly develop an industry that was seen as having great potential to take advantage of the natural resources of the country.

Accidental cause:

Some explanations given by the interviewees may also be interpreted as accidental cause, in which the explanations of the causal theories refer to unguided actions and consequences (Stone, 1989).

Narrative 7: Permissive regulation

Several interviewees, for example, bureaucrats and producer firms, pointed out that, prior to the crisis, there were regulations for the salmon industry: the General Law of Fishing and Aquaculture (GLFA), the Environmental Regulation (RAMA), the Sanitary Regulation (RESA) and the Regulation on Hydrobiological Plagues (REPLA). NGOs opined that these regulations were not extensive, very generic, and weak, and did not accord with scale of development of the industry. Moreover, they were deficient in protecting the environment and the sanitary assets of the country, in this case an ISA-free country. A representative from the banking sector mentioned '…the state managed badly the regulation, because there was very little regulation, because gave few resources to target regulation, Sernapesca was a shame, as an institute it was a shame…'.

All interviewees agreed that the industry grew faster than the development of regulation. This point was mentioned by a representative interviewed from a Public Agency when he said '…the state with public policies has always been lag behind than the progress of the private sector, in all sectors, obviously, the business issue goes much quicker, much faster than the state's response…'. The GLFA was created in 1989, and the Environmental, Sanitary and Hydrobiological Plagues Regulations were created in the 2000s; this means that the industry operated without environmental and sanitary regulation in its main expansion period, as was explained by an interviewed NGO. A representative from an association opined that those regulations had a short term vision and were an approach aimed at addressing the consequences of the problems rather than their causes and with no attention to the impacts of problem in the long term. This point was exemplified by a bureaucrat when she said '…for the escape of salmon there was a measure that was rather a mitigation measure and not a prevention of salmon escape. It was never assumed in the escape that it was necessary to take care about the safety of the structure to prevent escapes. It was always thought, well, if there are escapes you have the obligation to recapture. That was the perspective of the regulation, precisely a more mitigation approach rather than a preventive approach…'. An interviewed consultant opined that the regulatory process did not incorporate a risk analysis that identified the critical points to be controlled. ‘Prior to the crisis even the word biosecurity was not used’, said an interviewed bureaucrat.

‘The state did not take responsibility for the importance of the industry’, an interviewed consultant said; ‘sanitary issues were not visualised and what could happen in sanitary terms was not in the agenda of the state’, it was recognised by a representative from Subpesca. The resources intended for regulation were few and not according with the importance of the salmon industry and aquaculture sector for the country. The state did not understand the aquaculture and its potential well, and earmarked few resources for administrative regulation for the industry. As a consequence of this the sanitary authority (Sernapesca) did not have sufficient infrastructural resources to control and monitor all the farming centres in the industry. An interviewed consultant described this in the following way, ‘…an authority that had few resources to monitor by itself...it is imperative to do so because firms generally may have not made a sufficient check, not even recognised clinical signs of diseases that were different from those which were attacking us, not only because they did not want to do that but because they ignored it, they did not report dangerous diseases. Then, in my view, the role of the state in sanitary surveillance was insufficient, it was little proactive’.

According to bureaucrats, Sernapesca had few capabilities and power to control the industry (producers and providers). In 2006, there were 637 grow out centres in operation: with scarce and non-suitable personnel, the authority could not control them all. For example, it was Sernapesca’s practice to ask the firm it was going to inspect for a boat to make the inspection. Some centres were supervised once a year and others once every two years. A bureaucrat said ‘…I think the system overall was slightly oiled like a little oiled machine. While the environmental regulation is from 2001, I would say, the last four years Sernapesca actually starts a far more systematic control to farming centres. Before that, in fact, Sernapesca was focused more on fishing than on aquaculture. Just four years ago, is where it really starts to look the aquaculture. Mainly the aquaculture for Sernapesca, which is the watchdog, is oriented to certification for export rather than to take charge of compliance with environmental, sanitary issues. Especially the control in the early years was focused on administrative inspections, if I have the papers that I should have to have, that kind of stuff, but the control was not very substantial…’. A consultant and a representative from a public agency agreed in their opinion, pointing out that there were controls in the processing plants because large buyers insisted on quality and sanitary standards in these facilities, however, no one was taking care of the sanitary conditions in the production of salmon.

A bureaucrat from Subpesca explained that there were crucial biosecurity activities performed by service suppliers that, due to a lack of capabilities, were not being supervised (e.g. the transport of live fish and monitoring of mortality) and that the control of all these activities was a responsibility of the private sector. 'Sernapesca did not have legal support to act effectively when the crisis started, for example ordering fish depopulation or unannounced visits to production installations', was said by a representative from a producer firm. Several interviewees pointed out that Sernapesca did not have access to crucial industry data, nor did it have the resources for surveillance or for discovering outbreaks of pathogens and diseases. Sernapesca was dependent upon firms for these activities and, although there were laboratories, their principal clients were the firms. Regarding this, a representative from the media noted, 'Sernapesca did not have the resources to control. That was not an issue; I think that was not an issue. It was an issue in the sense that we have officials who control but the farming centre could do all its production process and the officials never came to take a sample. In Canada you have the inspectors who go every month to take their samples, but apart from the inspector you have an independent entity that is elsewhere and then these samples are put together, this is, there is an independent body, more than one laboratory, both oversee every month the production randomly, of course; after this they compare these samples... always there is a risk that humans collude and that the businessman gives money...it is human. So to avoid that, they have two separate entities, the government, but they at the same time have this private laboratory'.

The industry was in the process of getting the highest production (by weight) at any cost, which implied a focus on the end of the production cycle rather than on the farming process, an interviewed bureaucrat explained. Thus, there was a great deal of pressure for the fish to finish its production cycle and this was usually achieved through a high use of medicines. Some NGOs point out that regulation on the use of medicines was not strict and the state was not supervising industry practices, for example, there was no control on the use of antibiotics. In the words of a bureaucrat from Subpesca '…regarding the issue of antibiotics there was a lot of misinformation…there was a strong suspicion that a lot of antibiotics were used, but there was no concrete evidence of what was used, then there were no concrete measures on that…'. An interviewed producer firm said that, at the time the sanitary crisis started, there were no specific programmes to control the sea lice caligus and prevent the industry from ISA, even when authorities knew that these parasites were implicated in the virus problems in other salmon industries, for example, in Norway. There were no procedures for identifying outbreaks of ISA or protecting the industry from ISAv because, in the RESA, ISA was listed in list 2 rather than list 1, and it was therefore assumed by regulations that the disease was already present in the country, an interviewed lawyer said. He mentioned, ‘according to me, they were wrong in copying…it is not a joke, in fact when the ISA crisis began, they stated to implement a policy that was issued only to the list 1, then after that they had to dictate a modification, and said, these rules can also be applied to the list 2, because ISA was listed in the list 2 and not in the list 1, and why was ISA on the list 2?, because when they made the lists they copied them from a paper or from some Norwegian or Scottish regulation, and ISA was listed in list 2 because Norway had ISA long ago, ISA in Norway is endemic, then as they had it on list 2, they copied list 1 and list 2, and ISA was listed in list 2 and in Chile we never have had ISA, it must have been in list 1 but it was in list 2’. A producer firm said that several months from the onset of the sanitary crisis the sanitary authority Sernapesca created the ISA contingency programme, however, this programme and the measures were again too late. In his words, ‘...we had to make an ISA regulation, this is, we spent a couple of months to originate a regulation that would allow you to have a legal ground to start working, and in a matter of viral diseases like these ones a week is too much. If we really wanted to have a contingency plan, that contingency plan should have been ready, like the avian influenza, everything is there, the plan, the regulatory framework is here, ready, then the outbreak came and we apply this. But we, the outbreak appeared and we said let’s begin to generate this and to have the legal ground to apply it...’.

An interviewed individual from an association explained that regulation on the import of eggs was also lax, with any sanitary measures concerning these being voluntary rather than any compulsory checks or certifications, and there was no adequate or accurate way of evaluating the sanitary status of the eggs. Some interviewees pointed out that one of the most prominent hypotheses about how the virus reached the country was via the import of eggs. This point was mentioned by a representative from the banking sector when he said ‘…I am totally convinced that the ISA came to Chile by overseas salmon eggs. This is a hypothesis, it is not proven, but for me this is the most probable hypothesis…’. And also mentioned by a consultant when he said ‘…there were firms that thought that we should be very drastic [with the eggs] because that was the origin [of the virus] and there were other firms that did not thought [that that was the origin of the virus]...’. In the same line, a deputy pointed out ‘…it is said that there was an intention from outside [the country], contaminated eggs,…that allowed to realise that the generation and control of the eggs was a not less important issue to solve…’. The enforcement system was ineffective in its structure and enforcement. An interviewee from a laboratory and two representatives from public agencies opined that the penalties were very low compared with the economic benefits of contamination (perverse incentive), and the capacity of enforcement was very low given a lack of resources to control the industry. Regarding the penalty, a bureaucrat said '...there are sanctions which are not sufficiently persuasive because it is more convenient to infringe the regulation than to pay the penalty...', and a representative from a public agency observed that '... the state considered a penalty, very small fines...the cost from the point of view of production per kilo salmon was maybe five Chilean pesos per kilo, that was practically zero…'.

An interviewed NGO pointed out that the scope of the role of the state was framed in the ideology of non-intervention. 'The state did not have much interest in regulating the industry because the industry was producing excellent economic results and regulation and control were seen as disincentives', he said. Instead, the state clearly supported an intensive production model via a free production approach and a concession scheme that promoted, depending on interpretation, a naïve reliance self-regulation or an excess of liberty for the private sector, opined a representative from a producer firm. There was no regulation to limit the biomass and capacities of concessions and farming centres; this was at the discretion of the private sector. An interviewed lawyer pointed out that 'the amount of fish was decided by you with your technical project. The state did not tell you how much you could produce, as it is in Europe where the state tells you how much you can produce'. The representative from the producer firm continues explaining that at the beginning of the 1980s, when the industry was small, the private sector asked for concessions closer to the coast where the infrastructural, logistics and social facilities were. He said 'the concessions were given indefinitely…the individual interests of concession holders were unlimited, and the State had little to say about their renewal or revocation…the State did not consider the possibility of a change in the size of the industry and continued granting concessions and the State did not have the legal resources to modify this concession regime'.

Narrative 8: Caligus

Across interviewees the opinion was shared that, at the time of the crisis, the industry was dealing with the highest level of caligus. For example, an interviewed Association said '…we had a very high caligus condition…we had more sea lice than fish'. Caligus is a sea louse parasite that produces injuries on the salmon that are entrances for viruses such as ISA. It has been demonstrated that caligus acts a vector for ISA. A representative from an association pointed out that the caligus was present in the Chilean industry before the sanitary crisis began in 2007. However, in 2007 it found more susceptible hosts to attack (i.e. immunologically weak fish living at high densities per cage and high concentration of farming centres), and more suitable natural conditions for proliferation, for example, weather conditions at the time of the crisis led to higher sea temperatures (see next narrative). Regarding this, an interviewed consultant noted '…the rates were declining since 2004 or so, all the production indicators were going down…and they stepped up when in late 2006 and early 2007 the caligus, increased five times its levels in fish and that has to do, I think, with a poorer immune status and protection of fish and with the high concentration of farming centres and with a large amount of biomass that was placed in the water. Then, the caligus was always there; but when it found fish that were easier for its action, it multiplied and grew, also associated with environmental changes that occurred in that period, which were declining rainfall and therefore higher salinity that favours caligus. That made the attack of caligus to fish causing injuries that obviously increase the risk that the fish is attacked by pathogens…then, in general, the disease rates increased and an opportunistic pathogen as ISA could be, which was latent, saw its major opportunity and then caused the problem'.

In an interview conducted by Ecoceanos in 2007, the researcher Sandra Bravo explained that, at that time, the industry was using the medication emamectin to deal with caligus. However, it was not effective since the salmon had already developed resistance to it. The industry needed to change the medicine but it was not possible because emamectin was the only product approved by the Agriculture and Livestock Service (SAG) to control caligus in fish. Also, Sernapesca did not have a contingency plan to deal with caligus because it was not considered a 'high risk disease'. There was no prevention in the control of caligus. A rotation in treatments would have helped to control it with emamectin, which is an effective and easy product to deal with this sea louse as the medication is supplied orally via the food (Ecoceanos, 2007).

Narrative 9: Natural conditions

Nature has a fundamental role in aquaculture activities. There are natural conditions that are not well known by both the industry and the state. As a representative from a producer firm explained, the sea has cycles and these cycles allow worse or better conditions for the development of pathogens. He described this in the following way, 'I think that there are a lot of factors at the level of nature that are not well known and I think that in the sea there are also cycles, cycles in which the conditions of the sea are better or worse for certain developments, and, I mean, the role I attribute to nature or to the environmental parameters, not well known in those years, they play an important role’. He also said that ‘there was some information that the virus was introduced into Chile around 1997, but it did not become endemic at that time because the conditions of the sea were not suitable’.

Another interviewed producer firm explained that in the region where the salmon production takes place, the last summers, prior to the emergence of the crisis, were hotter than usual. The higher sea temperatures contributed to the proliferation of the sea lice caligus, which makes salmon susceptible to diseases such as ISA. In the words of the interviewee ‘…this area had three summers that were quite hot...it was like we were in a more mild than cold area as it is usually. I remember having stayed for two or three summers going to the beach until March and that is not common here. The temperatures of the waters increased and that is undoubtedly a factor that triggered the crisis…’. Also, unlike in Norway, the geography of Chile and ocean currents do not provide natural barriers to the dissemination of diseases. As the interviewee said ‘…Canada and Norway are geographically very different from Chile. Norway are fjords like fingers which are independent of each other and that they go to the Atlantic. Here is the Atlantic and each fjord is different from this one…but our country is different, we are all in an inland sea, where the waters are common…’. The Norwegian geography forms natural barriers between fjords where the production of salmon is performed. In Chile, there is a high density of farms in areas without natural barriers.

Intentional cause:

There is one explanation about why the Chilean industry had a sanitary crisis in which the realisation of a purposeful action had the wanted consequence. Stone (1989) refers to this as an intentional cause.

Narrative 10: Industrial sabotage

A representative from a public agency opined that one hypothesis about why and how the virus appeared in the country was that the Chilean industry was deliberately infected with ISAv to reduce its competitiveness. The virus suddenly appeared at the central point where the production takes place, from where it rapidly and easily spread, and no-one knows how it got to that strategic place. The capabilities of the sanitary authority failed in detecting this situation. The industry took advantage of this sabotage to reduce the highest industry cost at that time, the workforce cost. Since the virus led to decreasing production, the industry had the perfect excuse to dismiss the surplus of employees. In his words, '…this impacted heavily on the regional economy, then, the possibility to improve the cost structure of the industry was seen, from that point of view…this is science fiction, since this is aquaculture, it is aquaculture science fiction, well…where do I put the bomb to be exploded?, in the central point, in the node. It appeared unexpectedly, no one knows how it appeared specifically there. If you see the distribution that was prior to the event, prior 2007, that was the focal point, plants, laboratories, flow of trucks, everything converged there, and from there, it radiated to the centre, everything is concentrated there. There, it was the 80% of salmon production in Chiloé, 80%. You placed your child with a cold…the whole kindergarten was infected'. This narrative is, of course, a type of conspiracy theory.

The composed narratives posed above suggest different social constructions that explain the reasons for the sanitary crisis in the Chilean industry. Each of these social constructions has an argument that interconnects different industry failures to explain why the Chilean industry had a sanitary crisis. The argument of each narrative is linked to distinct forms of thoughts or forms of understandings that this research refers to as cognitive frames (Stone, 1989; Surel, 2000). These cognitive frames have premises that form the basis for the arguments. The cognitive frames are not necessarily exclusive to an actor or group of actors in the industry. Individuals within different categories of actors can explain the causes of the crisis through the same cognitive frame; however, sometimes it is more evident to associate the cognitive frame of some individuals to their role or profession within the industry. There were five cognitive frames apparent in the narratives that emerge from the interviews:

1. The *biological-sanitary cognitive frame* is based on the premise that the salmon is more susceptible to diseases when it is weak and stressed. Black and Pickering (1998) mention some stressors[41] as: the water quality, the handling and confinement of salmon, salmon nutrition and high rearing densities. The key impacts of stress on performance are mortality rates, behaviour, poor growth and food conversion, reproduction and product quality (Black and Pickering, 1998; Hedrick, 1998).

   In this cognitive frame the sanitary crisis in the industry is explained by the susceptibility of the salmon to diseases. The disease ISA occurred because of the interaction of a

[41] 'A stimulus or event that provokes a stress response in an organism' (http://medical-dictionary.thefreedictionary.com/stressor Last accessed: 1 February 2013).

susceptible host (salmon), appropriate pathogen (ISAv) and suitable environmental conditions. The ISAv was the appropriate pathogen due to the high levels of caligus, a vector of ISAv and negative biological externality, faced by the industry in 2007. The most prominent environmental condition supporting the development of the disease was the high densities of salmon, which increased its stress and compromised its immunological system, making it more susceptible to diseases.

This cognitive frame is more related, but not exclusively, to fish health scientists, fisheries biologists and fish epidemiologists. The second narrative, negligence of the industry in fattening up salmon, and the eighth narrative, caligus, belong to this cognitive frame.

2. The *biological-environmental cognitive frame* is based on the premise that the environment, such as unusual weather conditions and poor water quality, stresses the salmon thus deteriorating its immunological system. Also, these conditions encouraged the development and spread of pathogens. Poor water quality is due to an intensive use of the common-pool resource water (high density of salmon), aquaculture activities and human impact (Black and Pickering, 1998; Hedrick, 1998). Black and Pickering (1998) point out that the respiratory activity of the fish decreases the dissolved oxygen and increases the levels of ammonia, carbon dioxide and suspended solids. It is known that low dissolved oxygen levels trigger stress responses. Buschmann (2006) refers to the occurrence of harmful algal bloom from the nitrogen given to the environment by salmonid farms. Algal blooms cause stress responses in salmon (Black and Pickering, 1998). Antibiotic and feed residuals are also contaminants to the marine environment that reduce the levels of dissolved oxygen (Pizarro and Zolezzi, 2003).

   In this cognitive frame the sanitary crisis in the industry is explained by an unsuitable environment that allowed the development of ISAv. This cognitive frame is more related, but not exclusive, to environmentalists, ecologists and oceanographers. The third narrative, negligence of the industry in contaminating the water, and the ninth narrative, natural conditions, belong to this cognitive frame.

3. The *shareholder primacy cognitive frame* is based on the premise that the needs of the shareholders are before any other needs. It is assumed that the primacy of shareholders is to increase their profit and therefore there is a primacy of profit (Stout, 2002; Robins, 2006).

The Chilean salmon industry took to an extreme the primacy of the maxim ‘maximising shareholder value’ and thereby the primacy of profit. It was operating on a short-term production-intensive model that under-emphasised the environment and the sanitary conditions necessary for re-production of salmon. Of course, this also meant that shareholder value was defined as a short term objective without regard to longer term value.

In this cognitive frame the sanitary crisis in the industry is explained by the ambition of the industry to maximise profits over and above environmental constraints. The first narrative, ignorance of the industry, and the fourth narrative, exacerbated desire to maximise profits, belong to this cognitive frame.

4. The *captured state cognitive frame* is based on the premise that the state was captured by the industry in the formation of the industry regulatory framework. Levine and Forrence (1990) and Laffont and Tirole (1991) refer to the regulatory capture. This can be applied to the salmon industry saying that the industry controlled the state and its public agencies to benefit itself through a suitable design and implementation of industry regulation.

   In this cognitive frame the sanitary crisis in the industry is explained by a lax and ineffective regulation to benefit the industry interests. The fifth narrative, blinded by economic success, the sixth narrative, self-regulation, and the seventh narrative, permissive regulation, belong to this cognitive frame.

5. The *failure of imagination cognitive frame* is based on the premise that no one imagined that the Chilean industry could be attacked through introducing a virus. The National Commission on Terrorist Attacks Upon the United States (2004) refers to the failure of imagination in the September 11 attacks, indicating that, in that case, although an attack could have been predicted, it was not planned. This refection can be used in the case of the salmon industry saying that this cognitive frame explains the sanitary crisis in the industry by the lack of imagination regarding undesirable situations against the industry. The tenth narrative, industrial sabotage, belongs to this cognitive frame.

The premises of the cognitive frames are built on paradigms (Hall, 1993). These paradigms represent ‘world views’ that establish how the world operates based on certain understandings, interests and beliefs. The premises of the biological-sanitary and biological environmental cognitive frames are closer to each other and connected through an ‘ecological’ view of the world, whilst the premises of shareholder primacy and captured state cognitive frames are closer to each other and connected through a 'neoliberal' view of the world. This suggests the existence of two paradigms: an ecological and a neoliberal. Since the failure of imagination cognitive frame is based on a lack of imagination to predict events, this cognitive frame may belong to either or both paradigms.

1. Ecological paradigm:

The biological-sanitary cognitive frame and the biological-environmental cognitive frame belong to this paradigm. These cognitive frames deal with the ecology; this is the interaction between the salmon as a biological being with other organisms and the environment (Biology online, 2009). In this interaction other organisms may be other types of marine entities such as fish, molluscs, humans, virus, bacteria and parasites, whilst the environment corresponds to the external conditions and stimuli with which the salmon and other organisms interact (Biology online, 2008). In the ecological paradigm it is understood, and interpreted, that the appearance of a disease is due to the breakdown of the 'ecological triad': the ecological triad is the relationship of the host, pathogen and environment (Hedrik, 1998). In this case it refers to the relationship of the host salmon, the pathogen ISAv and the culture environment (e.g. quality of water, human interaction, fish threats and weather). The disease is a process characterised by "any impairment that interferes with or modifies the performance of normal functions, including responses to environmental factors such as toxicants and climate, nutrition, infectious agents; inherent or congenital defects, or any combination of these factors" (Wobeser, 1981, quoted in Hedrick, 1998, p.108). Figure 5.1 shows the causation for diseases from an ecological triad view.

The ecological paradigm pays attention to the relationship between environmental stresses and biological responses; that is, on the impacts of stress on salmon performance. Environmental stresses consider both the aquacultural stresses (Black and Pickering, 1998) and stresses produced in the aquaculture environment by natural circumstances and human and industrial action (e.g. increase in water temperature by a hotter season or volcano eruption and human water pollution). Aquacultural stresses are those related to aquaculture activities such as water quality, physical salmon disturbance, environmental temperature, salmon social interaction, nutrition and treatments (Black and Pickering, 1998). In the sanitary crisis the key impact was on mortality rates. Redclift (1992) states that the meaning of sustainable development of a perspective based on ecological parameters is the natural resource base. In the ecological paradigm of the salmon industry the object of sustainability was the natural resources.

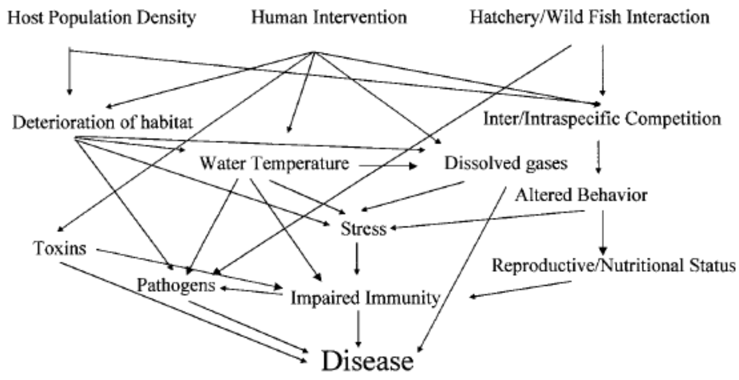

Figure 5.1: A web of causation for diseases.
Source: Hedrick (1998).

2. Neoliberal paradigm:

The shareholder primacy cognitive frame and captured state cognitive frame belong to this paradigm. These cognitive frames deal with a core aspect of the neoliberalism: minimal state intervention. Deregulation, private sector power, elites oriented to business and finance, market and export orientation, and short-term vision are some elements that characterise a neoliberal paradigm (Mudge, 2008). The environmental consequences of neoliberalism (e.g. short-term vision on natural resource exploitation and privileges to foreign investments), has certainly been negative. Chile is one of the countries with clear examples of this, for example, the overexploitation of the sea bass and forestry (Harvey, 2005). The focus on short-term returns and the problem of opportunistic free riders that may disadvantage firms that take a longer term view are also part of a neoliberal paradigm. Following Redclift's (1992) discussion on sustainable development in the neoliberal paradigm of the salmon industry, which was based on economic parameters to maximise benefits of economic development, the understanding of sustainable development was related to the level of production and consumption.

The following figure shows the paradigms and cognitive frames linked to narratives.

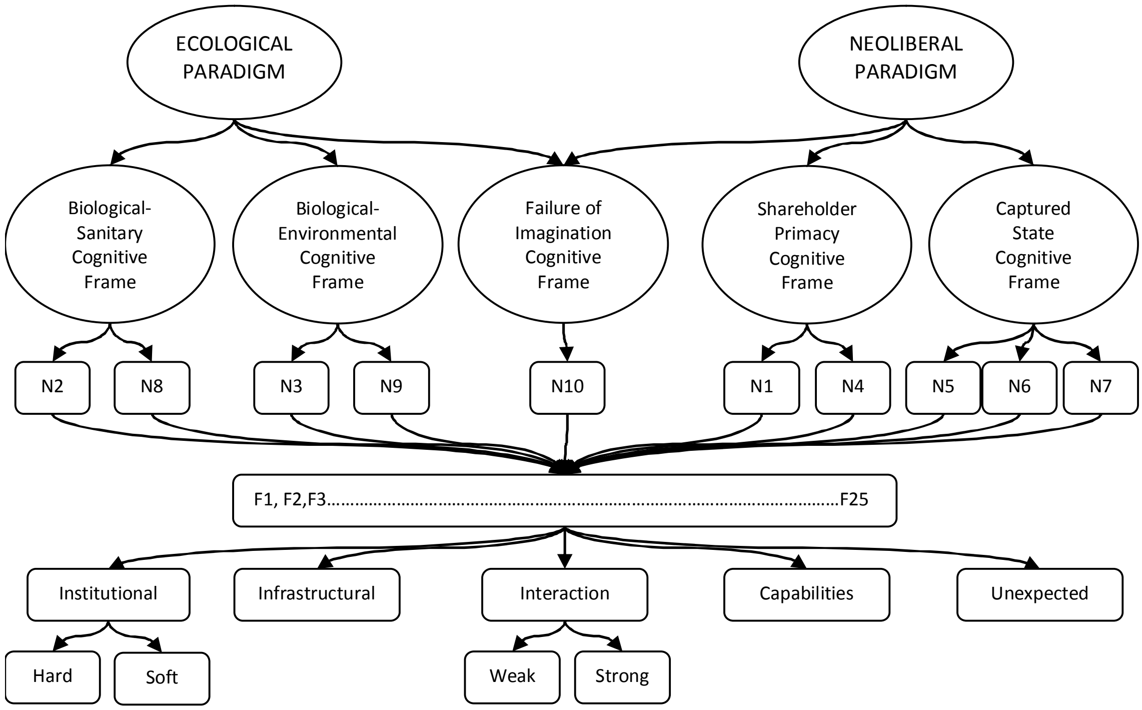

Figure 5.2: Paradigms and cognitive frames

N: Narrative; F: Failure

Source: Own elaboration based on Woolthuis, Lankhuizen and Gilsing (2005), Stone (1989), Surel (2000), Hall (1993) and data analysis.

The ten narratives posed above, and the premises of the five cognitive frames, claim that the industry, including its initial industry regulatory framework (design and implementation), was framed in a neoliberal paradigm that neglected ecological parameters, which are at the core of an ecological paradigm. Since the neoliberal paradigm was the dominant paradigm in which the industry was developed, from the beginning of the industry the locus of authority, and therefore the allocation of power, has been in the neoliberal paradigm in imposing the premises, forms of action and instruments of this paradigm in policies.

The sanitary crisis faced by the industry with environmental results was a clear consequence of this neoliberal paradigm frame that partially stimulated the failures in the industry. The way in which the neoliberal paradigm understands sustainable development is in unison with the export-oriented model, which has characterised the Chilean economic orientation since 1975 (Barton, 1997). It is also in unison with the construction of competitive factors for non-traditional sectors such as aquaculture, which includes a favourable concession scheme to attract private capital and little regulation to the sector.

Although the industry was developed within the neoliberal paradigm it does not mean that the neoliberal frame or view of the world was an exclusive one. The entry of diverse actors into the industry (Barton and Fløysand, 2010) pressuring an ecological view of the world (e.g. environmental NGOs, researchers, marine biologists) to be considered in policies reveals the presence of an ecological paradigm. As will be seen in the next chapter, the sanitary crisis explicitly initiated a competition between the neoliberal and ecological paradigms for reframing the industry policy. The crisis challenged the dominant neoliberal paradigm and gave the opportunity of a paradigm shift from a neoliberal paradigm to an ecological one.

Considering the construction of identity function states by Surel (2000), and Sabatier's definition of advocacy coalition (1988), that also includes the interests of actors as a unifying element, we may say that the neoliberal and ecological paradigms constructed two distinct coalitions: the neoliberal coalition and the ecological coalition. The most prominent actors representing the neoliberal and ecological coalitions were the producer firms and the NGOs, respectively.

The understanding, interests and beliefs of bureaucrats and government decision makers, as institutional actors that face institutional constrains and incentives (Layzer, 2006), are shaped by the strategies and techniques used by the coalitions in translating the coalition's understanding, interests and beliefs into policies.

The remaining actors, such as public agencies, private institutes, associations, trade unions, supplier services, media, universities and the banking sector, may also join the coalitions according to their own understandings, interests and beliefs, and/or be biased and influenced by the most prominent actors representing the neoliberal and ecological coalitions.

The industry sanitary crisis pushed sudden and unexpected changes in policies that served as the basis of the deliberations for updating the industry regulatory framework, including the modifications of the GLFA, RESA and RAMA, and was a starting point of policy learning in the industry. At the time of the onset of the crisis, the sanitary, environmental or other regulations did not include specific measures to deal with ISAv (outbreaks and spread), nor did they have a wider frame in which to measure and deal with the virus, such as coordinated productive actions, strict disinfection and fallowing that could be implemented and enforced. This meant that there was no policy ready to deal with ISA, nor a legal framework on which it could quickly build specific control measures such as, for example, in the Scottish case in which regulations could be adapted to deal with ISAv. The Chilean industry and the sanitary authority Sernapesca were unable to anticipate sanitary problems due to ISAv. As an interviewee from a programme linked to the industry explained, part of the explanation is that ISA was listed in list 2 (i.e. a disease that is distributed at length in the national territory) in the RESA and therefore the warning systems were not looking for this disease. The industry systems (regulatory and non-regulatory (e.g. practices)) were not protecting the country and industry from ISAv. This became a call to modernise the warning, control and mitigation systems of the industry.

5.2. Sanitary crisis as a policy window and precipitator of policy learning and policy change

The sanitary crisis hit the industry with the rapid dissemination of ISAv in farming centres belonging to different firms and spreading to Region XI. At that point, it was urgent to stop the epizootic infestation, reduce fish mortality and control the spread of the virus and the disease. As said in the previous section, this concern was defined as the first policy problem. Since this sanitary problem faced by the industry was qualitatively and quantitatively different from routine emergencies, new and specific measures were needed to deal with the virus. The urgency of the situation meant that government and industry actors quickly mobilised to develop and implement immediate measures. The policy subsystem (Sabatier, 1988) involved in finding the solution for the first policy problem was composed by the government through Sernapesca, Subpesca and Salmon Roundtable, by the industry through Intesal, SalmonChile, and other industry Associations and by national and international experts.

When ISAv was reported to Sernapesca by Marine Harvest, through the sanitary authority (Sernapesca) the government took immediate actions to deal with the virus. Sernapesca formed a committee composed of experts in pathology and virology from Universidad Austral, Universidad de Chile, Intesal[42] and representatives of salmon industry. The aim of this committee was to elaborate a contingency plan for ISA. This plan was decreed on 6 August

[42] Intesal (acronym for its Spanish name Instituto Tecnológico del Salmón) is the technological platform of the Association of Salmon Industry (SalmonChile). Created in 1995, it coordinates research programmes and monitors and tracks salmon activities. It has worldwide linkages with universities and key research centres. It monitors the needs and technological developments in the industry to promote and implement standards and conduct of its members, recommendations to internal and external entities to obtain the highest levels of information, competitiveness, sustainability and in order to anticipate the trends of clients and stakeholders (http://www.salmonchile.cl/frontend/intesal.asp?secid=23 Last Accessed: 2 January 2011).

2007 (two months after the index case) by Sernapesca, and mandatory actions[43] were codified in Resolution N°1670 (Chilean National Congress Library, 2007a) to prevent the propagation of the disease. These were the first measures taken to address the incidence of ISA in Chile.

The measures of the Contingency Plan were adopted in coordination with the Chilean Army, Port Works Direction, National Environmental Commission, Port Firms in Puerto Montt (Region X), Superintendence of Health Services, Transport Maritime Firms and the salmon industry. These responses were inspired by control programmes and technical information from the international experiences of other countries who had dealt with the virus (see section 3.2), and from recommendations of the World Organisation for Animal Health (OIE) (Subpesca and SalmonChile, 2008).

The international experiences showed that useful measures in the control of the virus were the elimination of the infected salmon and periods of fallowing of the farming centres. Chile adopted the same actions that other countries such as Norway and Canada had employed, which involved the elimination or early harvest allowances of affected cages after an ISA alert, the report of changes in the disease by diagnosis laboratories and producer firms, and the establishment of quarantine and vigilance areas with control of the movement of food, nets, mortality, equipment and personnel (Subpesca and SalmonChile, 2008).

The non-existence of a contingency plan for ISA in the country prior to the sanitary crisis was due to ISA not being considered in the list of monitored diseases that represent a hazard to the country (list 1). According to the sanitary regulation, RESA, there are two lists of diseases. List 1 corresponds to high risk diseases (dangerous diseases) that are not present in Chile; the sanitary authority demands tests to be run and has surveillance programmes over those diseases in order to protect the country from them. In list 2 there are diseases that are assumed to be present in Chile and therefore the regime for dealing with those diseases is different from those used to deal with diseases in list 1. As a representative from a Programme said, warning systems were not looking for ISA in order to protect the country.

According to some interviewees there are two possible explanations why ISA was listed in list 2. A Lawyer interviewed during fieldwork said that this could have been a mistake in the

[43] They were: i) Elimination or harvest of cages with fish infected with ISA, ii) Definition of quarantine and surveillance areas, iii) Restriction of movements from the affected areas, iv) Strict biosafety measures, v) Special harvest and processing conditions for centres located in areas under quarantine and vigilance, vi) Smolt and breeder fish check, vii) Water disinfection systems in process plants, viii) Permanent monitoring and vigilance of the centres in affected areas and other areas related to outbreaks, and ix) Weekly report of mortalities in farming centres as an early alert.

elaboration of the lists. Chile copied the lists from other countries such as Norway or Scotland were ISA has been listed in list 2 for a long time because those countries have had ISA since the 1980s and 1990s (i.e. ISA was listed in list 2 due to a legislative drafting error). A representative from a Programme said that, because the disease was detected in Coho salmon in the 1990s, the disease was listed in list 2. If the second explanation is true, it was a reasonable decision to put ISA on list 2. However, it was not a reasonable policy to ignore the risks of diseases on list 2. Whilst there was a means for dealing with exotic diseases, those for dealing with diseases in list 2 were not very effective.

An interviewed bureaucrat from Sernapesca said that the non-existence of a contingency plan for ISA was a mistake in normative terms, a lack of institutions. At the same time the bureaucrat thought that the response from Sernapesca was very quick compared to Norway. However, the opinion of a representative of a large producer firm disagreed and strongly criticised the focus of the contingency plan. According to the producer firm a contingency plan is a plan that should be made in advance within a surveillance programme. Thus, when an outbreak appears the contingency plan is applied and it allows the containment and elimination of the outbreak. In this way, the Chilean Contingency Plan was a delayed plan since it was developed after the virus had already spread across the industry. The firm representative opined that, at that point, the plan was a control plan and not a contingency plan and explained that the authority spent two months in developing a regulation as a legal ground to start working and dealing with ISA. In viral diseases like ISA even a week is too much time to react. In the words of a producer firm representative, 'if Chile really wanted to have a contingency plan it should have already been developed and ready to be implemented at the time of the first ISA outbreak'.

The measures enforced in the Contingency Plan were complemented with voluntary measures adopted by the industry. In August 2007 the Association of Salmon Industry, SalmonChile, developed additional biosecurity measures in order to prevent the dissemination of ISAv (Subpesca and SalmonChile, 2008). Three months after the index case, Intesal, firms and other organisations organised an international workshop to provide the government and the Chilean industry with guidance on the detection of the virus, surveillance and control measures and regulatory tools on ISA. This workshop helped to design specific control measures for ISA (Alvial *et al.*, 2012).

Table 5.2: Immediate responses

<table>
<tr><th colspan="3">Instruments Taxonomy</th></tr>
<tr><td rowspan="3">Authority-based policy instruments</td><td>Command-and-control-regulation</td><td>Contingency measures (Resolution N°1670)</td></tr>
<tr><td>Self-regulation</td><td>Voluntary measures of the industry</td></tr>
<tr><td>Advisory committees</td><td>Expert Virology Committee
International advice</td></tr>
</table>

Source: Own elaboration based on analysis, Hall (1993) and Howlett, Ramesh and Perl (2009) as theoretical base.

The development and implementation of new and specific measures to deal with ISA demonstrated that the sanitary crisis in the salmon industry abruptly opened a policy window, 'an opportunity for advocates of proposals to push their pet solutions, or to push attention to their special problems' (Kingdon, 2003 p.165), to reform the regulatory framework of the industry. As will be analysed in the next chapter, this policy reform was a turning point and, in the words of Keeler (1993), a 'policy innovation [for the industry] that may manifest an unusually substantial redirection or reinforcement of previous public policy' (p.434). This policy window gave the opportunity for major changes (Kingdon, 2003) that consisted of a shift in the policy paradigm of the industry (Hall, 1993) from a neoliberal to an ecological paradigm (this will be discussed in the next chapter).

As the policy window was opened due to the urgent need to solve the crisis and its effects, relevant actors looked for alternatives to solve the first policy problem. No direct previous Chilean experience with ISA implied a lack of knowledge in the industry and sanitary authority to detect and identify the virus, but it also meant that the required knowledge and solutions to deal with the virus and solve the crisis was not in Chile but in other salmon industries as those described in section 3.2. The immediate responses mentioned above reflect this. Both available solutions abroad and local political support to address the first policy problem kept the policy window open for the Chilean industry.

This policy window was an unpredictable opportunity to push the attention on special problems and radical proposals (Kingdon, 2003). However, the sanitary crisis itself was partially predictable by environmental and labour NGOs, artisanal fisherman, universities, public and private institutes, and the national and international media. Their environmental and sanitary critics have always been part of the salmon industry development. They argued that under the conditions in which the industry was operating the occurrence of an environmental and/or sanitary crisis was easily predictable. Nevertheless what could not be predicted was exactly when this crisis would occur.

Some interest group and supplier services interviewees literarily referred to the sanitary crisis as a 'chronicle of a death foretold', making the analogy with the novella of the same title written in the 1980s by Gabriel García Márquez[44]. As a representative from an association pointed out, 'it was sought to maximise the production but without knowing if that was actually feasible or if it was known it was ignored or it was decided to believe that what happened was not going to happen. In our opinion this was an announced chronic'. 'Since 2000 we are monitoring the industry. If you see our website, you can go day by day seeing what happened. Everything that happened was announced in advance. 'A representative from an NGO quoted García [Gabriel García Márquez] as saying, 'this was the chronicle of a salmon crisis announced'.

The analogy between the novella with the salmon crisis is interesting, not only in a broad sense in which those interviewees relate the title of the novella to their belief of 'this crisis was predictable and expected', but also in a narrower sense where, in the novella, although the anticipated murder of a man was publicly known, nobody did enough to prevent it. This was either because some of them did not believe the murder would actually happen or because those who believed it were too excited and distracted with the arrival of the Bishop to the town. In the novella there is also a woman who is ignored when she tries to convince the Mayor of the town about the murder. The Mayor paid little attention to the woman and although he confiscated the knives of the future killers he let them go. Later on the killers committed the crime.

According to fieldwork there was a common and public knowledge among actors (e.g. the salmon industry, bureaucrats, interest groups, policy makers, researchers and media) about the real possibility of a sanitary and/or environmental crisis since the conditions in which the industry was operating were unsustainable. 'Everyone knew that a crisis was coming but nobody knew how or when', a researcher from a University pointed out. Sooner or later a crisis would happen and this crisis could be triggered by any pathogen or environmental factor. However, no one did enough to prevent it. Producers were too busy and satisfied ('excited and distracted') in maximising their profits, meeting the quantities required by the markets and believing that if nothing 'bad' has happened up to now, there is no reason to be concerned that something bad would happen. Bureaucrats were relaxed and tolerant on the industry self-regulation discourse and without sufficient resources to enforce regulation. The government

[44] Original Spanish title: Crónica de una Muerte Anunciada, published in 1981. Gabriel García Márquez was a Colombian novelist, short-story writer, screenwriter and journalist. Considered one of the most significant authors of the 20th century; he received the Nobel Prize for Literature in 1982.

was satisfied ('excited and distracted') with the results of the industry and therefore more regulation or enforcement was seen as a disincentive. The banking sector was tranquil and confident about the results of the industry. Groups such as NGOs, artisanal fisherman and universities were ignored.

In the suspense novel view of the world a murder is deliberately planned, i.e. premeditated. The author of this research does not think the sanitary crisis was premeditated, even though this possibility was mentioned during fieldwork with the issues of motive and opportunity addressed by the potential for economic gain and the pre-existence and availability of contaminated salmon eggs from Norway. However, like most conspiracy theories (an intentional cause in Deborah Stone's (1989) framework), the actor or actors responsible remain in the shadows. It is clearly beyond the scope and interest of this research to pursue this investigation.

The immediate responses to the crisis were recognised as being insufficient because the contingency plan and voluntary measures of the industry partially addressed the problems revealed by the crisis and represented by the industry failures, as discussed in the previous section of this chapter. After some experience and evidence had accumulated, subsequent short-term responses were developed and applied. In May 2008 a working group was formed at governmental level with the public institutions related to the aquaculture to analyse the situation due to ISAv and to propose short-term measures for the salmon industry, including the improvement of industry production and sanitary conditions (Aqua.cl, 2008f; Aqua.cl, 2008e; Aqua.cl, 2008h). This group was called the Salmon Roundtable (Mesa del Salmón in Spanish) and comprised representatives from:

- Ministry of Economy leading the group
- Undersecretary of Fishing (Subpesca)
- Marine Undersecretary
- Fisheries Service (Sernapesca)
- National Environmental Commission
- Agency for Economic Development
- Marine Resources Area of Fundación Chile
- A Scientist, and
- An Executive Secretary

Sources: Sernapesca, 2009 and Chilean National Congress Library, 2010d.

Although Fundación Chile is a private non-profit organisation, it was invited to participate in the Roundtable due to its crucial role in the development of the salmon industry. Felipe Sandoval, a former Undersecretary of Fishing, was appointed as the Executive Secretary of the Roundtable, and acted as policy broker (Sabatier, 1988) between the government, the industry and other related actors. A task that the Salmon Roundtable urgently addressed was the review of aquaculture regulations as well as their implementation and effectiveness to face and address events such as ISAv. The analysis of the location of farming centres and the way they operated, including their related activities mainly services, was used as feedback for the Roundtable to conclude the need for change in the aquaculture regulation's approach. Thus, the second defined policy problem was to update the industry regulatory framework including the development and implementation of new policies and the modification of existing policy instruments. The subsystem (Sabatier, 1988) involved in defining the second policy problem was the Salmon Roundtable.

The Roundtable had the freedom to meet, negotiate and reach agreement with actors. However, it was within its remit to make decisions to develop and propose formal actions to be presented to the government and decision makers. Since accepted solutions need to be built upon and to reach consensus among a variety of actors who have different understandings, interests and beliefs, the process of reaching consensus takes time. However, the industry was in crisis and therefore it was imperative to decide rapidly on what to do. An interviewee member of the Roundtable opined that the rationale of the government in forming the Roundtable with just public actors and Fundación Chile was to reduce the level of conflict among actors and to reach agreement in the proposals rapidly. However, this was not the case and the proposals made by the Roundtable created a high level of conflict and ambiguity among actors. The diversity of industry failures created divergent and incoherent narratives (as was demonstrated by the ten narratives posed in the previous section) about the causes of the crisis. This represented a major problem in the design and implementation of the short-term measures because the actions that were guided by those narratives were also divergent. This point will be treated in detail in the next chapter.

Since the sectoral regulatory framework prior to the sanitary crisis could not solve the crisis itself (there was a need to enact strict sanitary measures to control the virus), and the relief approach of the aquaculture regulations was shown to be ineffective to prevent the industry from events such as ISA, the problems caused by the crisis opened the policy window to reform the regulatory framework of the industry (Kingdon, 2003). In this way, the ISA crisis focused the attention on the industry regulatory framework and from there to address some industry practices.

As May (1992) and Hall (1993) discuss, the changes in policy precipitated a social and instrumental policy learning process. As in the case of economic policymaking in Britain analysed by Hall (1993), the policy learning process of the Chilean industry was conscious and intentional; however, unlike what Hall (1993) points out, it responded directly to the crisis and indirectly to past experience and new information. In the Chilean salmon industry it was '*a deliberate attempt to adjust the goals or techniques or instruments or establish new goals and create new techniques of industry policy in direct response to the ISA sanitary crisis and indirectly to past experience and new information*'. In this case, the sanitary crisis (an outside factor for the state) played the primary role in accelerating the process of developing policy for the salmon industry.

Industry participants played a crucial role in the policy learning and policy change processes of the industry. As was repeatedly said by interviewees during fieldwork, these processes were initiated by industry (private) initiatives and not from the public (government) sector. As will be seen in the following chapters, the autonomy of the state in making policy was limited by the pressures of the addressees and other actors such as NGOs and artisanal fishermen. The conflict among them and with the government was an important driver in the policy learning and policy change processes of the industry.

As said before, a long time before the sanitary crisis there was a set of indicators and feedback that supported an ecological view of the industry problems. However, these indicators and feedback were ignored and looked over as positive indicators of production, exports and employment. When production indicators declined because huge numbers of salmon started to be killed by ISAv, they were related to ecological indicators such as the dissemination of diseases and from there connected with feedback about the location of farming centres and the conditions in which the industry operated. Thus, the two defined policy problems indirectly involved ecological elements.

The policy problems defined by the sanitary crisis were framed within the neoliberal paradigm, even when some indicators and feedback were showing that the conditions that led the industry to the crisis were ecological ones. More precisely for framing the industry and its development within a neoliberal paradigm that neglected ecological issues critical for an industry that works with the ecology and natural and biological resources. This was because the subsystems defining the policy problems had a neoliberal view of the industry. They were worried about the decrease in salmon production rather than the sanitary and environmental problems of the industry, and as will be seen in Chapter 6, the regulatory changes they proposed were in unison with a neoliberal view related to maintaining the levels of salmon production. The policy problems were translated to the development of specific regulations to the industry to ensure the survival of salmonculture and a continuous growth in production.

The sanitary crisis in the industry reinforced the pre-existing perceptions of sanitary and environmental failures, and in this way it renewed the conflict between the ecological and neoliberal coalitions and the tension between the ecological and neoliberal views on sustainability and the way to achieve sustainable development. The ecological and neoliberal coalitions understood the root cause of the sanitary crisis in the industry differently. Within the ecological paradigm it was understood that the problems of the sanitary crisis were those related to the abuse of natural resources and the breakdown of the ecological triad. For the ecological coalition, the root cause of the crisis was the transgression of ecological limits although it recognised that the regulatory framework prior to the crisis played a crucial role in this.

In defining the policy problems of the industry, the ecological coalition was active in providing strong evidence on the relationship between the sanitary crisis and the abuse of the environment. Implicitly the goals of an ecological paradigm were well established indicating that the salmon production needed a (more) sustainable approach as the only way to survive over time. An interviewed NGO belonging to the ecological coalition clearly indicated that 'the production of salmon is not and will never be a sustainable activity; however, it might be done with better sanitary and environmental standards'.

By contrast, within the neoliberal paradigm it was understood that the problems of the sanitary crisis were those related to the deregulation of the sector. For the neoliberal coalition the root cause of the crisis was a lack of regulation for the industry and the sector in which the industry is immersed. The ecological and neoliberal coalitions agreed that prior to the crisis there were important regulations and programmes to protect the industry from hygienic and environmental problems: these included the environmental regulation RAMA and the sanitary regulation RESA. However, there was a policy failure of the regulatory framework in protecting the industry from ISAv and in playing a crucial role in developing the conditions that led the industry to the crisis. It was also agreed, but mainly by the ecological coalition, that the inadequate practices of the producers also contributed to the crisis. There was no agreement by interviewees on whether the regulatory framework prior to the crisis was just wrongly designed, rightly designed and inadequately implemented, or both wrongly designed and inadequately implemented as well.

5.3. Synthesis of the chapter

Long before the sanitary crisis occurred in the Chilean salmon farming industry, different actors were providing indicators and feedback about the critical sanitary and environmental situation of the industry to government officials. Moreover, a decline in the industry productivity particularly since 2004 was observable. This feedback was ignored and not seen as a signal of a coming crisis requiring urgent transformation of the critical situation of the industry involving its intensive production model, or as a problem to be faced by policy makers and government officials. However, when ISAv was introduced into the country and started to kill salmon, the magnitude of salmon fatalities and the infestation of farms across the industry could not be ignored. It did not take long before the crisis was defined as the first policy problem with a high priority in the governmental agenda. Thus, the sanitary crisis in the industry was a focusing event, that is, a situation that attracted the attention of individuals in and around the government, and government officials decided to do something.

Policy responses were based on the causes of the crisis. According to fieldwork there was a variety of explanations about the causes of this crisis and the existence of many interdependent failures that can be seen as having led the industry to the crisis were shown. The diversity of industry failures created divergent narratives linked to different cognitive frames that identified the existence of two paradigms – the neoliberal and ecological paradigms. Since the response to the crisis depended upon an understanding of its causes, the divergent narratives created divergent policy responses.

At the time of the onset of the crisis there was no policy ready to deal with ISA nor a legal framework on which it could quickly build specific control measures. Since the sanitary problem faced by the industry was qualitatively and quantitatively different from routine emergencies, new and specific measures were needed to deal with the virus. The urgency of the situation meant that government and industry actors quickly mobilised to develop and implement immediate measures. The first immediate action was the elaboration and implementation of a Contingency Plan that contained the first measures taken to address the incidence of ISA in Chile. The measures enforced in the Contingency Plan were complemented with voluntary measures adopted by the industry.

However, the immediate responses to the crisis were recognised as being insufficient because they only partially addressed the problems revealed by the crisis and represented by the diversity of industry failures. After some experience and evidence had accumulated, subsequent short-term responses were developed and applied. These short-term measures, including the improvement of industry production and sanitary conditions, were proposed by the governmental working group Salmon Roundtable. A task that this Roundtable urgently addressed was the review of aquaculture regulations as well as their implementation and effectiveness to face and address events such as ISAv. The Roundtable concluded the need for change in the aquaculture regulation's approach.

The update of the industry regulatory framework, including the development and implementation of new policies and the modification of existing policy instruments, was defined as the second policy problem. Both policy problems were framed within the existing neoliberal paradigm because the subsystems defining the policy problems had a neoliberal view of the industry. The policy problems were translated in the development of specific regulations to the industry to ensure the survival of salmonculture and a continuous growth in production.

The sanitary crisis in the salmon industry abruptly opened a policy window to reform the sectoral regulatory framework because the industry regulatory framework prior to the crisis could not solve the crisis itself (there was a need to enact strict sanitary measures to control the virus), and the relief approach of the aquaculture regulations were shown to be ineffective in protecting the industry from events such as ISA. Thus, the crisis pushed sudden and unexpected changes in policies precipitating a policy learning process. The policy learning process of the Chilean industry was a conscious and intentional process; however, unlike what Hall (1993) points out, it responded directly to the crisis and indirectly to past experience and new information.

CHAPTER 6

POLICY RESPONSE TO THE SANITARY CRISIS IN THE CHILEAN SALMON FARMING INDUSTRY

"We never plan our regulations, we have never done a priori regulatory modifications in order to avoid undesirable situations. We always react, always…"
(An interviewed Lawyer)

This chapter analyses how policy responded, in the short and long terms, to the sanitary crisis in the Chilean salmon industry. The industry policy learning and policy change is analysed following the evolutionary stages of the sanitary crisis. It is argued that potentially radical measures are expected to occur in early stages of the crisis. Whether those measures actually produce a radical policy change in later stages of the crisis remain as a question. To analyse this, a bridge between policy learning literature and literature on disasters and crises management is made posing the main theoretical contribution of this research.

The chapter begins with an overview of the policy learning and policy change processes of the salmon industry after the sanitary crisis. Then, the second part makes an analysis of the short-term industry policy learning and policy change, which involves the development and implementation of new measures to deal with the virus and the participation of the neoliberal and ecological coalitions in those measures. The third part of the chapter analyses the long-term policy responses and how the short-term measures affected those responses.

The primary conclusion will be that, following the immediate policy response described in the previous chapter, the ISA sanitary crisis was not sufficient to produce a policy paradigm shift in the industry, but it did provoke a fundamental change in the industry's production model as the processes of policy learning proceeded. This fundamental change in the industry's production model introduced, through discussion and consideration of new ideas, changes in policies that progress in the direction of a more ecological paradigm. The studies of Hall's (1993) policy paradigm shift, May's (1992) instrumental and social learning, and Sabatier's (1988) coalition formation are used as a theoretical base. The relationship between a policy paradigm shift and the fundamental change in the industry production model is made by an analysis of the stages of a policy regime change as proposed by Howlett, Ramesh and Perl (2009).

6.1. Policy learning and policy change from the sanitary crisis

Chapter 2 points out that, in order to provide a more comprehensive and systematic analysis of how policy responds to catastrophic events, it is necessary to connect the evolutionary phases of those events with policy learning and policy change processes. This section takes forward that idea and analyses how the policy responded to the sanitary crisis in the Chilean salmon industry, how the processes of industry policy learning and policy change progressed according to the evolution of the crisis, and whether the changes in policies were incremental or radical.

The sanitary crisis was a dramatic event that disrupted the governance processes of the Chilean salmon industry including its regulatory framework. The crisis progressed from a critical period of urgency in 2007 to a new improved state of industry operation in 2010. The policy responses to the crisis were developed and delivered in different phases, and the changes in policies were outcomes that accompanied the industry's policy learning process.

Once the crisis and the update of the industry regulatory framework became policy problems, the relevant actors began to look for proposals and alternatives to solve those defined policy problems. Since no policy was preventively developed to deal with ISA in a pre-event stage of the crisis (i.e. there was no pre-event stage), proposals to solve the policy problems were developed in the stabilisation stage (reaction phase). The Chilean industry and government neither prevented the emergency of ISAv nor protected the industry from it, even when the industry was aware of the existence of this virus, which was not new to the world and had been affecting the global salmon farming industry since 1984.

Multinational companies located in Chile, such as Marine Harvest Chile S.A. (a subsidiary firm of Marine Harvest ASA) and Mainstream (a subsidiary firm of Cermaq ASA), are from those countries that experienced ISA crises before Chile; however, they did not take measures against it. This means that the industry did not experience a proactive policy leaning process but industry policy responded reactively to the sanitary crisis and in this way there was a reactive policy learning process.

In the precursor stage of the crisis, industry, government and other actors interpreted the signals that warned about the coming crisis differently. For the NGOs, it was apparent that an environmental or sanitary crisis would come soon due to the poor environmental and sanitary conditions in which the industry was operating. However, for the producers and government, the decrease in the production indicators was seen as a normal consequence of the intensification of the salmon biological resource.

After the ISA crisis occurred there were immediate or urgent policy responses, short-term and long-term responses. The immediate responses were developed and applied during the stabilisation stage of the crisis (during the first three months after the index case: June-September 2007), short-term policy responses were developed and applied during the normalisation stage (from the fourth month to the first year and half after the index case: October 2007-January 2009), and long-term responses were developed and applied during the improvement, adjustment and restoration stages (after the first year and half from the index case: January 2009-onwards).

The following sections show how, during the early stages of the sanitary crisis, measures considered as potentially radical were introduced into the industry. It was in these stages that non-routine responses were required to address the unusual problems the industry was experiencing because of the crisis. Also, the effect of those measures on the long-term policy learning and policy change of the industry are analysed.

As seen in Section 5.2, the policy problems linked to the sanitary crisis were framed within the neoliberal paradigm. This framing shaped the policy alternatives to solve those problems. The policy making process in developing and delivering the policy responses to the crisis was characterised by high levels of conflict and ambiguity among different actors and over distinct policy issues. The Executive Secretary of the Salmon Roundtable and policy makers played an important broker role in limiting this conflict to obtain a politically acceptable response to the policy problems posed by the industry; however, this did not entirely resolve the problems at any stage.

6.2. Short-term policy response

The short-term policy responses were developed and applied during the normalisation stage, a period where the short-term needs of the salmon producers (the affected community) were to stop salmon deaths and restore the levels of production prior to crisis as soon as possible.

Since no policy was ready to deal with ISA, during the first stages of the crisis the short-term responses were mainly a new set of policies oriented to the detection and control of the virus. In April 2008 specific measures to control ISA were decreed by Sernapesca in the Resolution

N°776 (Chilean National Congress Library, 2008e). These new measures complemented those established in the Contingency Plan and were aimed at reducing the incidence of ISA and isolate it geographically. They strengthened the control on farming centres, embarking and disembarking ports, roads and movements of fish. Early harvest or depopulation of cages and mortality treatments were stipulated.

It was also decreed that a resolution on solid and waste measures should be issued within 10 working days from the publication of Resolution N°776, i.e., during the second half of April 2008. In July 2008, measures to manage solid and liquid waste in slaughterhouses on land, and process plants receiving salmon species from farms in quarantine areas due to ISAv, were set and decreed by Resolution N°1882. These specific measures were for solid organic waste to be sent to fishmeal and fish oil plants, solid organic waste for final disposal, cleaning and disinfection proceedings, and methods of disinfection for liquid waste. In the specific case of solid organic waste for disposal, a silage process for organic waste was required that employed closed containers to which formic or acetic acid was added.

In July 2008 alternative and additional measures, provisionally for protecting and controlling the introduction of high risk diseases through salmon eggs, were set via Resolution N°1803 by Sernapesca. This resolution decreed that for the import of salmon eggs from countries in which ISA is present, the eggs should be verified as being free of the agent causing ISA through screening of broodstock of those eggs. Broodstock showing positive for ISA, eggs from that broodstock, and eggs sharing an incubator with eggs from positive ISA broodstock, were prohibited from entering Chile. This resolution on salmon eggs specified that the techniques to perform screening should be RT-PCR or PCR in Real Time using heart and gills as samples.

In October 2008 the first Specific Sanitary Programme for ISA was established by Resolution N°2638 (Chilean National Congress Library, 2010i). This Programme added new regulatory requirements related to health and fish disease. Although it did not mention Coho salmon and rainbow trout as vectors or carriers of ISA, it mentioned, but did not specify, other susceptible hydrobiological species. The programme proposed the definition of authorised laboratories by Sernapesca to diagnose ISAv and the methods to isolate and identify the virus. It also established a notification system that included holders of farming centres and laboratories, creating an explicit obligation to report to Sernapesca ISA outbreaks and the presence of the virus. This information should be supported by a Veterinary Report or The Positive Result from an authorised laboratory. It was also a requirement to submit an epidemiological survey provided by Sernapesca. An important component of the programme was that it established the categorisation of zones and farming centres. For surveillance zones a minimum of 10 km radius from an infected area or suspected centre was defined.

The Sanitary Programme clearly established that regulations for cleaning, disinfection and biosecurity should be followed. All these regulations are from 2003, for example Resolution N°72 on General Sanitary Programme of Cleaning (Chilean National Congress Library, 2003c) and Resolution N°65 on General Sanitary Programme for Disinfection of Salmon Eggs (Chilean National Congress Library, 2003b). Farming centres should have written protocols for cleaning, disinfection and biosecurity to be applied, for example, to harvesting, massive cull and mortality. These protocols were to be approved by Sernapesca and all the personnel in the farm should be aware of them. Another specification of the programme was the *a priori* authorisation by Sernapesca of the movement related to aquaculture activities among farms such as live fish, mortalities, harvest and cull. Sernapesca was to issue a sanitary certificate for movement. In 2008 Sernapesca established an additional measure to restrict the movement of cages related to the broodstock detected with ISAv in Llanquihue Lake (Region X) (Sernapesca, 2008b).

In 2007 Sernapesca incorporated the sea lice caligus as a high risk disease in List 2 because caligus was considered to be an important disease present in Chile and was also a vector of ISA. The Specific Control Sanitary Programme for Caligus enacted by Resolution N°1883 (Chilean National Congress Library, 2007c), and the Specific Surveillance Sanitary Programme for Caligus enacted by Resolution N°1789 (Chilean National Congress Library, 2007b), were created in 2007, and in 2008 part of the Specific Control Sanitary Programme for caligus was replaced by Resolution N°448 (Chilean National Congress Library, 2008d).

Together with the development and implementation of new regulations, through its website Sernapesca started a public information campaign to permanently identify infected farms showing the centres that were at risk of spreading the virus. This was in order to provide the producers with crucial information about the virus and its incidence, and encourage other farming centres to adopt preventive measures (Sernapesca, 2008b). All these measures represented a substantial increase in Sernapesca's responsibilities.

The range of responsibilities undertaken by Sernapesca was considerably wider than that prior to the crisis. It was recognised during fieldwork by a member of Sernapesca that the resources available to perform these responsibilities were quite limited, and by several interviewees that Sernapesca did not have the capabilities to effectively perform the new tasks. An interviewed lawyer explained that Sernapesca was not a high level technical body, that most of the professionals in the regions were newly graduated veterinarians without experience, and that the organisation did not have enough resources to perform the new activities.

To support the short-term measures the government through CORFO provided a loan guarantee to producer firms. This government financial aid consisted of a guarantee to get bank credits to fund investments in sanitary areas, and in this way it was an incentive for the firms to invest in the new measures to control ISA. The state guaranteed up to 60% of the credits with a limit of US$8 million per firm. According to El Mercurio, in total the state guaranteed US$120 million for the industry (El Mercurio.com, 2008a).

Chile was interested in developing knowledge exchange mechanisms and transfer knowledge between the Chilean industry and those industries that had experienced ISA crises before (e.g. Norwegian, Canadian as it was described in section 3.2) to know how to deal with ISAv and solve its sanitary effects. For example, a study to investigate the virus origins in Chile was made by the Canadian University Prince Edward Island (La Tercera.com, 2009), and the report on risk factors relating to the spread of the virus was made by the Norwegian Scientific Committee for Food Safety (Norwegian Scientific Committee for Food Safety, 2007). Although this sanitary crisis in the Chilean industry represented a country specific problem, experiences from other places and times were employed to look at alternatives to solve this problem in the Chilean context.

As was pointed out in Section 3.1, since the virus was not new in the world, the knowledge to solve this specific problem was located in those countries where the virus had existed and been considered as a disease for the salmon industry such as Norway and Canada. In this way, using international expert advice and experiences from other places Chile experienced a policy transfer process such as those discussed by Rose (1991).

The urgency and new responses to control the virus in order to stop the salmon mortalities, and the fast mobilisation of actors meant that the short-term responses were potentially radical to cause a policy paradigm shift in the industry. Whether these policies caused a shift in the industry policy paradigm or not would be observed after their implementation and when some experience and evidence was accumulated. Within this new set of policies, the most potentially radical change in the industry came in 2008 with the development and implementation of the new industry production model, called the Health Management Area Model (HMAs), codified in Resolution N°450 (Chilean National Congress Library, 2009f), Resolution N°1449 (Chilean National Congress Library, 2010g) and resolution N°93 (Chilean National Congress Library). This model was a fundamental change in the production of salmon in Chile. It was inspired by the Canadian Bay Management Area Model discussed by McGeachy and Moore (2003), as it was described in section 3.2, and shares the similarity that the territory had been organised to have coordinated management of salmon production. However, one difference between the Canadian and the Chilean models was the number of involved firms, which in the end had an effect on the model's operation. According to Aqua, in Chile there were 28 firms involved, while in Canada there were just 4, which facilitated industry coordination (Aqua.cl, 2010a). With this new production model all the measures already developed as immediate and short-term responses would be more effective, since the model would organise the farming centres to control the virus and ensure production in a more effective way.

The HMAs were the only alternative proposed as a new form of industry organisation. The model was proposed by the neoliberal coalition, represented most prominently by the producer firms, and promoted by the Salmon Roundtable. According to international experience, coordinated management of farms was a crucial measure to control the virus in those countries that implemented the model, such as Canada and Norway. It was believed that the new model would help to recover the salmon production and ensure a continuous growing production. However, if it was a crucial measure to control the virus in Chile, this would be demonstrated by its effectiveness in the Chilean context.

The ecological coalition, represented most prominently by NGOs, did not propose an alternative model to the HMAs and its participation was mainly focused in contesting the model proposed by the neoliberal coalition. Perhaps it was not in the interest of the ecological coalition to propose an alternative model because the members of the coalition were most likely to oppose the farmed salmon production, and because the coalition also constituted a loosely linked group without formal existence.

The adopted solutions were framed within the neoliberal paradigm of restoring levels of salmon production. As will be seen in the next chapter, features of the new industry production model, such as fallow periods and coordinated production, led to restrictions in salmon production, a consequence that created discontent in some producers, and contested the extent to which the actual policy response continued to be solely aligned with the neoliberal paradigm.

In summary, drawing lessons from other salmon industries, the key instruments developed to deal with the first policy problem (i.e. the sanitary crisis itself) were the Contingency Plan codified in Resolution N°1670 (Chilean National Congress Library, 2007a), the Measures to Control ISA codified in Resolution N°776 (Chilean National Congress Library, 2008e), the Specific Programme for ISA codified in Resolution N°2638 (Chilean National Congress Library, 2008c), and the Health Management Area Model codified in Resolution N°450 (Chilean National Congress Library, 2009f), Resolution N°1449 (Chilean National Congress Library, 2010g) and Resolution N°93 (Chilean National Congress Library, 2010j). International advice in the form of workshops and studies were mechanisms of knowledge transfer used by Chile to produce information about the virus and its spread in the national territory.

To introduce fundamental changes in the industry Chile adopted the same measures to control ISA that other salmon-export countries such as Norway, Canada and United States, aimed at detecting the disease and new outbreaks at the earliest opportunity, control of fish cages, restrictions in the movement of fish, the creation of zones, depopulation of farms and elimination of fish when required, fallowing, and more control from the sanitary authority Sernapesca.

Thus, to solve the first policy problem, the industry adopted a positivist ‘best practice’ model of policy learning (Freeman, 2006), in which experiences from other places and times were transferred and adapted to the Chilean context, introducing fundamental changes in the production model of the industry. The purpose of a positivist ‘best practice’ model was to find the most cost-effective solutions. These solutions were ones that could inform effectiveness and feasibility. However, effectiveness and feasibility are related to the similarities of institutional context between systems of comparison. As we will see in the next chapter, the implementation of this model led the industry to conflicts and ambiguities and a new phase of policy learning.

Table 6.1 presents the short-term policy responses to the sanitary crisis. The majority of policy instruments developed to face the sanitary crisis were in the form of Command-and-Control-Regulation. It suggests that some difficulties in implementing them may be in the compliance of the standards set by the regulations, the risk of regulatory capture, overregulation, and the lack of resources (capacity) and capabilities for effective enforcement of the policy instruments, as will be seen in Chapter 7.

Table 6.1:Short-term responses

Instruments Taxonomy		
Nodality or information-based instruments	Public information campaigns	Dissemination of infected farms through Sernapesca website
Authority-based policy instruments	Command-and-control-regulation	Control measures (Resolution N°776) Solid and liquid waste measures (Resolution N°1882) Eggs measures (Resolution N°1803) Sanitary Programme ISA (Resolution N°2638) HMAs regulations (Resolutions N°450, N°1449 and N°93) Specific Control Sanitary Programme Caligus (Resolutions N°1883 and N°448) Specific Surveillance Sanitary Programme Caligus (Resolution N°1789)
	Advisory committees	Salmon Roundtable
Treasure-based policy instruments	Guarantee for loans	State guarantee fund CORFO

Source: Own elaboration based on analysis, Hall (1993) and Howlett, Ramesh and Perl (2009) as theoretical base.

6.3. Long-term policy responses

Long-term policy responses were developed and applied during the recovery phase of the industry's sanitary crisis. The recovery phase of the crisis began a year and half after the index case, after the worst part of the crisis was over. The long-term responses mainly addressed the second policy problem, not only to update the industry's regulatory framework including the development and implementation of new policies and the modification of existing instruments, but also aiming to continue with the control and spread of ISA (i.e. first policy problem).

The policy subsystem (Sabatier, 1988) involved finding the most appropriate institutional solution to solve the second policy problem was developed by the government employing Subpesca, Sernapesca, Salmon Roundtable, public agencies and policy makers; the industry itself through producer firms and its different associations (associations of producers – SalmonChile and Acotruch[45], associations of service suppliers such as Association of Maritime Shipowners, Association of Divers and Association of Nets); environmental and labour NGOs,

[45] Association of Coho Salmon and Rainbow Trout Producers.

other associations such as the National Corporation of Fishermen, banks through its association ABIF, trades unions and Universities.

The recovery phase of the crisis included the improvement, adjustment and resolution stages. As said in Chapter 2, in evolutionary models of policy learning we can find some loops in the development of policies. In the case of the Chilean salmon industry, since new policies were being developed and implemented, they were tested and adjusted in the light of experience and new information. Then, the improvement stage overlapped with the adjustment stage. The resolution stage had not yet occurred; this was because the salmon industry had not completely restored its industry governance processes because the industry regulatory framework had not been completely routinised.

The potentially radical policy responses developed as immediate and short-term measures to deal with ISA proved to be ineffective in containing the virus in the original area (Region X), in providing a model that ensured the continuous production of all the Chilean salmon species, or in controlling some industry practices adequately. This called for further reforms that occurred during the recovery phase of the crisis and, in this way, continued the industry's policy learning. The changes in policy during the recovery phase were the creation, changes and adjustments in policy instruments and their settings. Changes in policy instruments were outcomes that gradually continued accompanying the policy learning process of the industry.

The improvement and adjustment of policy instruments was made by incremental policy changes that were revealing an increasing degree of the ecological paradigm. The long term response was a participatory process in which the authorities were willing to receive observations and comments on the policy instruments from the addressees (i.e. producers and suppliers). The experience in implementing the instruments allowed the actors to obtain information and give feedback to the authorities. The amendment of instruments was a bottom-up process in which producers and suppliers influenced the adjustments of the measures based on their understanding, interests and beliefs in an active way. Their strategy was to report the infeasibilities of the instruments and attempt to influence instrument adjustments in favour of their interests.

The incremental policy change in the industry had a constructivist approach of policy learning, and the adjustments of policy instruments emerged as a collective process of knowledge accumulation from the interaction and participation of the different actors (Sabatier, 1993; Sanz, 1995). In the words of Freeman (2006) this model 'treats policy as emergent. Policy does not exist somewhere else in finished form, ready to be looked at and learned from, but is finished or produced in the act of looking and learning' (Freeman, 2006, p.379).

The main regulatory change in the industry came with the process of reform of the 1989 GLFA, with the aim of incorporating a preventive problem-solving approach and institutionalise the new production model of the industry. As said in Chapter 5, the regulatory framework for the industry prior to the crisis had received strong criticism about its reactive rather than preventive approach to support industry development. Both the ecological and the neoliberal coalitions agreed that the regulatory framework prior to the crisis contributed to the development of the conditions that stimulated the failures in the industry, and subsequently the sanitary crisis. Changes introduced in the GLFA allowed for a more effective implementation of the new production model assurance to the banking sector on the financial possibilities of producer firms.

The review of the aquaculture regulation including the GLFA was conducted by the Salmon Roundtable. The proposals made by the Roundtable were presented to policy makers in the Law Project to modify the GLFA N°18892. According to the History of the Law N°20434, the project was submitted to the Congress for legislative process by Presidential message with high priority on 8 January 2009. It was submitted to the Chamber of Deputies as the chamber of origin, and therefore the reviewer chamber was the Senate. The modifications were made in four areas: alterations in the farming centres model, alterations in the mechanisms to facilitate aquaculture concessions as mortgages, strengthening the power of Sernapesca and increase the payment of aquaculture fees. The topics contained in the project were:

1. The introduction of a new production model based on the creation of Health Management Areas (HMAs). The HMAs have been a crucial recommended international measure to face and reduce the impacts of sanitary events such as ISA. These areas refer to the coordination of the operation of farming centres that are located in an area that, given its features (e.g. by group of hydrobiological species), should be managed independently from others. The areas consider high biosafety measures and fallow periods. They contain a group of concessions and at the same time are grouped and contained in bigger areas called macro zones. These areas allow the creation of firewalls to contain outbreaks of diseases and isolate contaminated farming centres. The following figure shows the levels of action in biosecurity measures.

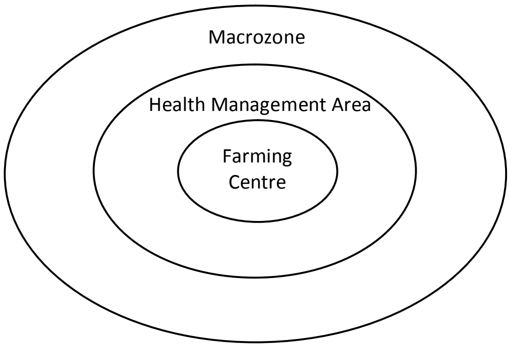

Figure 6.1: Levels of action in biosecurity measures
Source: Subpesca.

Given the situation of ISA, the creation of HMAs in Regions X, XI and XII was urgently required. The areas were aimed at controlling the virus in Los Lagos and Aysén Regions, and to avoid the implementation of an intensive production model in Magallanes that led the industry to the crisis. In order to organise the regional fish aquaculture, the indefinite suspension of the procedure of applications and granting of fish aquaculture concessions was proposed in the Los Lagos Region, and the suspension for one year in Aysén Region.

With the creation of HMAs the relocation of concessions was also proposed as part of their implementation. Since the coordination of the operations of farming centres was required, the holders of farming centres would occasionally need to relocate to areas where coordination with other farming centres was easier, or to areas more suitable to operate fish aquaculture (e.g. deeper areas). The relocation of concessions would require renouncing the concession that would be relocated, and the acquisition of a new concession in a new area under different requirements, such as 25 renewable years.

The relocation of farming centres would also be done (apart from the relocation of concessions) by transferring the concession holder to another area where a new farming centre was acquired. In order to speed up the procedure of transfer of farming centres, a concession record to implement concession transfers and cession of rights was created.

The possibility that these areas may be declared by group of hydrobiological species that will facilitate the creation of the HMAs in the future was also incorporated in the declaration of areas suitable for aquaculture (AAA for its Spanish acronym).

2. The possibility of giving concessions as real collateral. To solve firms' financial problems and ensure a scale development of the industry, it was realised that the regulatory framework should be upgraded to facilitate the concessions as real collateral. Although it

was always possible to give a concession as collateral[46], in practice there were practical problems that made its implementation difficult.

3. The performance of Environmental Reports INFAs and certification by suitable third parties. With this change the authority took the possibility of collusion due to the strong connection between clients and providers of INFAs seriously. To do this, Sernapesca had a record where suitable professionals would be registered to elaborate the instruments of environmental and sanitary evaluation to which the GLFA and its regulations refer.

4. To include the regulation of aquaculture related activities in the sanitary regulation. Since activities related to aquaculture (e.g. aquaculture suppliers) play a key role in maintaining good sanitary conditions in farming centres, they should meet sanitary requirements in order to avoid being carriers of pathogens. This expressly includes establishing the facility to stipulate the elimination of species in order to control high risk diseases. The sanitary programmes would be in charge of the implementation of the measures to do that.

   Strengthen the control faculties of Sernapesca. That is, to give more power to the sanitary authority to inspect activities that, in the past, were not explicitly mentioned. These activities include, for example, collection centres, slaughter centres and feed plants, which at the moment of the project law may be just controlled by SAG. Also the time to control activities (i.e. control activities could be done out of working hours) was extended. An Automatic Positioning System (POSAT for its Spanish acronym) in ships transporting materials among farming centres would be required.

5. To improve the enforcement system in order to make it effective. To address environmental and sanitary infractions, the application of administrative sanctions (i.e. they may be applied by resolution of Subpesca) would be incorporated. Also a more preventive approach in environmental regulations was implemented. This was done by reducing the time required for remediation of anaerobic water conditions by suspending the farming centre's operations until suitable environmental conditions are proven to have operated for at least one production cycle. Environmental information would be approved by Sernapesca and meet farming conditions such as density, cultivation, harvest and fallow.

6. The increase of the cost of the aquaculture fees.

[46] According to the Law N°20091 from 2006.

Since the chamber of deputies and the Senate had disagreements on the Law Project and its amendments, a Joint Commission was formed to propose a way of solving those disagreements. After fifteen months in legislative process, the new law (Law N° 20434), as an outcome of the modification process of the 1989 GLFA, was promulgated, published and implemented. The formation process of the Law N°20434 is summarised in the following table.

Table 6.2: Formation process of the Law N°20434

Phase	Steps	Stage	Period of Time
Initiative	Initiative through Presidential Message	First Constitutional Stage	8 January 2009 – 20 May 2009 (133 days)
Discussion of the Project Law	Project Law is presented to Chamber of Origin (Deputies)		
	Project Law is approved by the Chamber of Origin (Deputies)		
	Approved Project (from Chamber of Origin – Deputies) passes to the Reviewer Chamber (Senate)	Second Constitutional Stage	8 July 2009 – 20 January 2010 (197 days)
	Reviewer Chamber (Senate) amends the approved Project by the Chamber of Origin (Deputies)		
	Revised (i.e. amended) Project by the Reviewer Chamber (Senate) back to the Chamber of Origin (Deputies)	Third Constitutional Stage	20 January 2010 – 20 January 2010 (1 day)
	Chamber of Origin (Deputies) rejects the amendments from Reviewer Chamber (Senate)		
	Formation of Joint Commission (equal number of deputies and senators) to propose the way to solve the disagreements	Joint Commission Stage	10 March 2010 – 10 March 2010 (1 day)
	Joint Commission reaches an agreement		
	Project from Joint Commission passes to the Chamber of Origin (Deputies)		
	Chamber of Origin (Deputies) approves the Project from the Joint Commission		
	Project from Joint Commission passes to the Reviewer Chamber		
	Reviewer Chamber approves the Project from the Joint Commission		
Sanction of the Project	Approved Project by both Chambers Deputies and Senate is approved by the President	Stage of Completion	16 March 2010 (1 day)
Promulgation	President announces the Decree for Promulgation	Promulgation	5 April 2010 (1 day)
Publication of the Law in the Official Newspaper	Text of the Law is published in the Official Newspaper	Publication	8 April 2010 (1 day)

Source: Own Elaboration based on the "History of the Law N° 20434" (Chilean National Congress Library, 2010d)

The legislative process of modification of the 1989 GLFA was, in general, a participative one. According to an interviewed NGO, the process in the Senate was more participative than in the Chamber of Deputies. The role of the President of the Senate, Senator Antonio Horvath, as policy broker (concept discussed by Sabatier, 1988) was crucial in opening up the discussion of the Law Project to the diversity of involved actors. Senator Horvath, as an environmentalist (he is known as 'the Eco Senator') and a native of Aysén, one of the regions affected by ISAv and the salmon industry, opened room for negotiations in which the actors were allowed to present their views on the Law Project. An interviewed policymaker and a representative from the NGOs explained that, apart from the discussions in the Congress, Senator Horvath collected information from the regions, and it is fair to say that he conducted all the necessary sessions so that no one was left unheard. As an interviewed NGO pointed out, 'there was not any actor who asked to speak at the sessions and has not been heard'.

With the discussions made at the Senate and the information collected from the regions, it was clear that the sanitary crisis was a more complex situation than what was presented in the Law Project. This was also recognised by a bureaucrat interviewee from Subpesca saying that, at the beginning (i.e. when the project was submitted to the Chamber of Deputies through presidential message), the Law Project was very weak and did not take into account labour and environmental issues in depth, as was required in later parliamentary discussions mainly in the Senate

During the legislative process there was criticism about the neoliberal approach of the Law Project and they provoked conflict among political parties. Some members of Congress, belonging to centre-left coalitions (the coalition in power at the time of the submission of the project), strongly criticised the treatment given to concessions, their time limit and possibility to give them mortgages, during the modification of the law. Those members argued that the project obeyed economic rather than biological criteria, and that economic parameters were privileged over ecosystem considerations[47]

[47] According to Dávila and Soto (2011), the economic paradigm is the predominant one in the approach of public policies in Chile. In public issues, the logic is focused on the analysis of resources and based on cost-benefit, efficiency and effectiveness criteria over other approaches. The expert knowledge of public policy usually comes from outside the government, and is located in *think tanks* that are linked to political parties. Moreover, Lahera (2004) notes that the modernisation of the government's action is given by the convergence of politics and public policy. This improvement requires, among other things, changes whereby political parties, social groups and citizens internalise the analysis and proposals made by pro-government and opposition policy institutes. On the role of citizenship, Dávila and Soto (2011) raise the question of what is the role of citizens and their organisations in the debate on the importance of expertise in public decisions in contemporary democracies.

. They pointed out that there were environmental and sanitary issues ignored in the Law Project, and that there was no difference between the approaches and positions of the Opposition (i.e. centre-right) and the Government, even when the Law Project was coming from a centre-left government (Chilean National Congress Library, 2010d).

The neoliberal position of the government was criticised for preferring economic priorities over biological ones, and a regulatory capture of the government from powerful groups was suggested. In the words of a congress member '…apparently behind the project there were powerful groups which seduced the government and the government instead of take care of the assets of all the Chileans went in the defence of the interests of the industry…' (Chilean National Congress Library, 2010d, p.768). It was said by some members of Congress that the project threatened the sovereignty of Chileans and favoured the privatisation of the sea, and that the time limit of concession did not obey biological issues (Chilean National Congress Library, 2010d). Those congress members agreed with the development of the industry but not with the neoliberal approach of the industry taken by the government.

Evidence collected through interviews indicates that, although the policy reformation process was in general a participatory one, some actors such as Coho salmon and trout producers, environmental NGOs and suppliers, were dismissed. Disagreements about the proposed measures and favouritism to some actors (e.g. Atlantic salmon producers) destabilised the consensus that the industry had before the crisis.

The modification of the GLFA took place during the presidential electoral year of 2009-2010. This electoral environment implied a political sense of urgency from the centre-left coalition, the coalition in power at that moment, to solve this sanitary crisis and its effects. This political sense of urgency reflected the political salience of a powerful political sector (i.e. needing results on important issues), and at the same time to get support for the coming elections from a broader cross-section of voters. The sense of urgency to approve the new law (outcome of the modification process) was translated in a feeling of something that in Chile is colloquially understood as a 'marmicoc legislation'[48]. A marmicoc legislation is understood as a rushed legislation with fast legislative process (the term is based on the analogy of something that needs to be cooked quickly).

[48] Marmicoc is the colloquial Chilean name and brand of the pressure cooker introduced into the country in the 1950s. In Chilean colloquial language something that is rapidly done is associated with marmicoc (http://www.marmicoc.cl/index.php?option=com_content&view=article&id=8&Itemid=2 Last accessed: 1July, 2013).

In order to conduct the process as fast as possible dissident views were not considered. A congressman pointed out in a Congress session that, during the modification of the law, there was a lot of pressure on the members of Congress and pressure from the Executive to approve the Law project submitted for modification (Chilean National Congress Library, 2010d). Interviewees agreed that lobbying was the most common mechanism during the legislative process used to influence the process of law modification. This observation is consistent with the study of Kingdon (2003) on policy change in the American context. The result of the presidential elections in 2010 (in a two round system) swung the government from a centre-left coalition to a centre-right coalition. The modification of the GLFA was one of the last projects undertaken by the centre-left coalition. The Joint Commission approved the project in Congress on 10 March 2010, a day before the handover of power. The new law (Law N°20434) was promulgated and published under the new coalition in government in April 2010.

The banking sector played a key role in the sector's learning process and during the modification of the GLFA. At the time of the crisis there was a high involvement of the banking sector in the industry. An industry bankruptcy (for not being able to face its financial commitments and not having operational money) would lead the banking sector to face massive financial problems. Thus, the negative financial effects of the industry were also a problem for the banking sector. The banking sector, represented by the Association of Banks (ABIF), soon realised that what it considered as collateral from the industry was not effective (an interviewee from the banking sector and financial advisors). Up to the sanitary crisis banks considered biomass as collateral, however, the sanitary crisis demonstrated that without biomass (in this case due to fish mortality because of ISAv) they did not actually have anything valuable that they could get from the industry if they were not able to pay back loans. This problem was translated as no real collateral for the banking sector.

The consideration of aquaculture concessions as real collateral would have solved this problem, but in the regulation of the period there were practical difficulties in allowing this. Given fallow restrictions, this collateral may also have been compromised from a risk management viewpoint. The approval of the new law untangled and accelerated the negotiations between the producers and the banking sector. As Claro y Asociados (2009) points out, with the approval of the law the banks had more guarantees to give credits to the industry, and the firms were in a better position and with more solvency to obtain new investments and attract new funding and commercial partners.

The Salmon Roundtable also worked on modifications of the sanitary (RESA) and environmental (RAMA) regulations. However, it was said that a change in the approach of these regulations would not be complete without the specific modifications in the General Law of Fishing and Aquaculture (Law N°18892) mentioned above in order to consider, reinforce and effectively enforce these amended instruments.

RAMA's first modification was published in April 2009 by Decree N°397 (Chilean National Congress Library, 2009a), a year before the publication of the new LGPA (Law N°20434). The key issues in RAMA's modification involved the adoption of measures for the disposal of solid and liquid waste coming from the production of salmon, the availability of an action plan for contingencies (similar to those established in Norway) in the case of producing negative sanitary and environmental externalities, actions to be taken for salmon escapes (including the recapture of the fish), and a secure disposal of waste and the elimination of dead fish. Sernapesca and the Marine Authority should be informed of these contingencies. Sernapesca and Maritime Authority should also be informed about fish escapes within 24 hours of the incident. The modifications also referred to net washing and specified that the removed nets to be washed could not be kept in the farming centres and nearby places.

There were some specifications for the INFAs and the time during which it was allowed to put fish into the water, according to INFAs. An important specification was that, from now, the INFAs should be performed by suitable qualified personnel with specialisation or experience in marine or environmental issues; laboratories performing INFAs should be accredited. In its inspection function, Sernapesca would perform the INFAs for farming centres as determined annually, acting as intermediaries between INFA's suppliers and clients. In this way the authority took the issue of the collusion between clients and providers of INFAs seriously, as they were seen as a strong network industry failure.

The first modification of the RESA was published in April 2009 by Decree N°416 (Chilean National Congress Library, 2009b), together with the modification to the RAMA, a year before the publication of the new law (Law N°20434). The modification of the RESA involved the specification of biosecurity measures such as disinfection of farming centres, net washing, removal of mortalities and silage, brood stock, eggs, farming centres on land, some practices such as all-in-all-out, sanitary certificates[49] for fish movements. There was a specific section to

[49] The policy learning process and the new operation of the industry increased the bureaucracy in the firms and in the industry. For example, there was a considerable increase in paperwork with the issue of sanitary certificates and a set of records that must be undertaken as required by the authority (e.g. a record of process of disinfection in slaughter centres and process plants), an interviewee from a laboratory pointed out.

the HMAs where a coordinated sanitary management was required, among other things the distance between farming centres was specified (1.5 nautical miles), and from farming centres and their areas (3 nautical miles).

Subsequent modifications of RESA and RAMA were enabled by Decree N°349 (published in May 2010) and N°350 (published in June 2010) respectively (Chilean National Congress Library, 2010b, 2010c). These modifications were made with the aim of improving some of the measures contained in the sanitary and environmental regulations. For sanitary regulations some concepts such as silage, incineration and recirculation of the fish pool were specified and from now any person with justified information about outbreaks may inform Sernapesca. Other adjustments referred to the farming centres located in land and their systems of mortality treatment, as well as issues about disinfection of places and aquaculture materials. For the environmental regulation the main adjustments were made on cleaning and washing of aquaculture materials such as nets.

Alterations to the GLFA and to the sanitary (RESA) and environmental (RAMA) regulations were made in light of the new knowledge gained from the control of the virus and the elements needed to effectively manage it. Also some adjustments in the settings of the HMA model were needed in order to modify the calendar months of the zones' fallow periods. This was made by Resolution N°2273 (Chilean National Congress Library, 2009e).

The majority of the adjustments were for regulations (policy instruments) related to the fundamental change in the industry's production model (HMA model), and this suggests the influence of the ecological paradigm in the policies that were adopted. There were several aspects to the adjustments:

- To incorporate the fallowing of collection centres. This was made by Resolution N°1897 (Chilean National Congress Library, 2010g);
- To update the calendar period of three months fallowing for the group of concessions in Region X, this was made by Resolution N°1898 (Chilean National Congress Library, 2010h) and Resolution N°1381 (Chilean National Congress Library, 2011h); Region XI, this was made by Resolution N°1897 (Chilean National Congress Library, 2010g), Resolution N°1898 (Chilean National Congress Library, 2010h), Resolution N°1381 (Chilean National Congress Library, 2011h) and Resolution N°2534 (Chilean National Congress Library, 2011r) and Region XII, this was made by Resolution N°2082 (Chilean

National Congress Library, 2011l) and Resolution N°2302 (Chilean National Congress Library, 2011p);

- To modify suitable areas for the Aquaculture in the Region XII. This was made by Resolution N°1215 (Chilean National Congress Library, 2011g);
- In Region XII, to adjust the macrozones by Resolution N°2003 (Chilean National Congress Library, 2011k) and group of concessions by Resolution N°2435 (Chilean National Congress Library, 2012g);
- To include new zones affected with ISA by Resolution N°756 (Chilean National Congress Library, 2011u) according to the ISA Sanitary Programme (enacted by Resolution N°2638) and the zonification (enacted by Resolution N°450), and exclude areas where new outbreaks have not been present and then to reclassify those zones as surveillance zones;
- To include affected zones in Region XI by Resolution N°2256 (Chilean National Congress Library, 2011o) and set complementary sanitary measures by Resolution N°1739 (Chilean National Congress Library, 2010f);
- To adjust the group of concessions in Region X and XI by Resolution N°2253 (Chilean National Congress Library, 2011n), Resolution N°2891 (Chilean National Congress Library, 2011s) and Resolution N°3104 (Chilean National Congress Library, 2011t).

The new law (Law N°20434) mandated the modification of the 1993 regulation on concessions and authorisations of aquaculture decreed by Decree N°202 (Chilean National Congress Library, 2011c), and that an Automatic Positioning System should be enforced on the vessels that provided services to the farming centres[50] (aquaculture service providers) in cases of conditions of sanitary risks among zones or groups of aquaculture concessions, this was decreed by Decree N°198 (Chilean National Congress Library, 2010a).

The creation of the group of concessions by the Law N°20434 required another update of the Sanitary Regulation, this was made by Resolution N°275 (Chilean National Congress Library, 2011d) and Decree N°56 (Chilean National Congress Library, 2011e) and the Environmental Regulation that was made by Decree N°168 (Chilean National Congress Library, 2011b). The new update in the Sanitary Regulation was to incorporate the concept of 'group of concessions' and to establish the 1.5 nautical miles distance among farming centres belonging to a group of concessions. It made clear that the exception to this distance would be made for

[50] These are vessels providing services to farming centres such as a transport service for live fish, dead fish and their products, food, personnel, nets and other elements for the containment of farmed species as well as fasten, flotation and protection elements (Chilean National Congress Library, 2010a).

concessions being relocated. It also set the distance requirements for the relocation of concessions and the conditions of operation for these concessions.

The update of the Environmental Regulation was to include that the farming centres should have an engineering study to specify the conditions of farming including methodologies to gather and process information. It pointed out that information about where the farming centre would be located should be specified, such as geographical, meteorological and oceanographic features, as well as procedures for installation, operation and maintenance. Also, there was a need to extend the start-up period of the operating conditions of sanitary management that should meet the biosecurity points of embarking and disembarking used in the activities of salmon farming. This sanitary management was enforced from 1 March 2013 by Resolution N°302 (Chilean National Congress Library, 2012h).

In 2009 the Specific Surveillance Sanitary Programme for Caligus and the Specific Control Sanitary Programme for Caligus were modified and integrated creating the Specific Sanitary Surveillance and Control Programme for Caligus codified by Resolution N°2117 (Chilean National Congress Library, 2009d). This was modified in May 2012 by Resolution N°1141 (Chilean National Congress Library, 2012c).

Regarding the creation of policy instruments, new regulations were developed to complement the set of regulations already issued in the reaction phase. Additional instruments were created, especially in the area of the HMA model by Resolution N°1896 (Chilean National Congress Library, 2011j), Resolution N°2238 (Chilean National Congress Library, 2011m), Resolution N°1548 (Chilean National Congress Library, 2012e) and Resolution N°1549 (Chilean National Congress Library, 2012f). These instruments were aimed at the operationalisation of new concepts introduced by the new law (Law N°20434) such as ‘group of concessions’ and ‘macrozones’. According to an interviewed bureaucrat from Subpesca, when the health management areas were created the concept itself (i.e. health management areas), and the maps made to define the areas, gave the impression to some actors, such as tourism providers and artisanal fisherman, that everything inside those areas belonged to the salmon industry, not just the aquaculture concessions to produce salmon.

Later, it was understood that the authority was adding the space among the concessions to the aquaculture concessions and that no one could operate there (e.g. fisherman or a tourist firm transporting tourists). This created conflict among different actors and it was, therefore, necessary to clarify that what the model actually did was to group aquaculture concessions producing salmon for coordinated operation. The macrozones are bigger areas containing groups of concessions with the aim of promoting the contention of sanitary emergencies. Thus, although in the language of the industry actors still talk about 'health management areas' or 'barrios' in a colloquial language, the new instruments created during the improvement stage set the number of groups of concessions of salmon aquaculture for the Los Lagos Region (24 groups of concessions), Aysén Region (37 groups of concessions) and Magallanes Region (27 groups of concessions), and the macrozones for Los Lagos Region (5 macrozones) and Aysén Region (3 macro-zones).

In 2011 a new and more complete version of the ISA Sanitary Programme was issued by Resolution N°1577 (Chilean National Congress Library, 2011i). The aim of the programme was the early detection of the virus and the opportune control of ISA. The previous programme codified in Resolution N°2638 (Chilean National Congress Library, 2008c) and its modification codified in Resolution N°2216 (Chilean National Congress Library, 2010i) were replaced in order to incorporate new procedures to improve the mechanisms of detection and control of ISA. According to an interviewee from Subpesca, the Chilean ISA Programme was a pioneer since it incorporated ISA control in fresh water and proposed the screening in broodstock.

Due to these measures, in 2010 Chile detected cases of HPR0[51]. From this detection the possibility of a risk effect was realised. Although HPR0 does not develop the disease it may mutate into the pathology that causes the disease. The elimination of broodstocks showing HPR0 and the eggs from these broodstocks was proposed. With this measures Chile was the first country to incorporate measures to control HPR0. In May 2013, at the request of Chile, the OIE agreed to consider ISAv infection for both virulent variables and the cause of subclinical disease (i.e. HPR0), and made changes to the Aquatic Code. These changes involved the consideration of HPR0 in the surveillance programmes of countries producing salmon, and the notification of the presence of HPR0 to the OIE (Aqua.cl, 2013c).

This demonstrates how policy learning at the local level may influence the policy learning of the industry at the global level. The knowledge and experience applied to the 2011 ISA Sanitary Programme, and the new information gathered about the virus such as the existence and recognition of HPR0, created the need to modify this Programme in 2013, which mainly incorporated the concept of 'compartment'[52], and to eliminate the harvesting restrictions to

[51] A virulent strain of ISAv that does not cause the clinical disease.
[52] This is one or more hatcheries with the same biosecurity management system containing a population of fish with a particular status of ISAv and ISA which are subjected to surveillance and control measures and meet the basic biosecurity conditions (Chilean National Congress Library, 2013).

the farming centres classified as confirmed HPR0. The update in the Programme also added information about the HPR0. This was codified in Resolution N°228 (Chilean National Congress Library, 2013).

In March 2013 the Density Regulation was established, which was designed by the authority but under consultation with the private sector and SalmonChile. The regulation was enforced from 1 January 2014, and regulates the quantity of fish firms can place into the sea according to the sanitary behaviour of the area in which the firms are located. There is a maximum limit of density per specie (17 Kg/m^3 for Atlantic salmon and 12 Kg/m^3 for Coho salmon and trout). Prior to the sanitary crisis the fish density reached 30 Kg/m^3 (La Tercera.com, 2013).

According to Aqua, to elaborate this regulation Subpesca used technical information and the collaboration of Universidad de Chile to set a density for each group of concessions. The idea was to avoid the overload of some farming areas (Aqua.cl, 2012c). The regulation also included an individual penalty for an excess of mortality that would be enforced six months after of the publication of the regulation (La Tercera.com, 2013). The authority estimated a reduction in the production of salmon (Aqua.cl, 2013h). The implementation of this regulation prevented the industry from growing.

The announcement of this regulation produced controversy in the industry, for example, SalmonChile asked the authority what would happen with those firms that harvested at a greater density since they had lower mortality, or whether an exception would be made. The authority replied that the regulation indicated that the density is a number of fish, therefore, what it was monitoring was the number of fish at the beginning and at the end. Therefore it never would be possible to have more fish at the end than those that were placed into the sea (Aqua.cl, 2012a).

In terms of suitable personnel to elaborate certificates, environmental and sanitary instruments, a regulation was issued pointing out that Sernapesca was the organisation empowered to keep records of suitable personnel, the requisites of those personnel, and that Sernapesca would entrust the elaboration of the certificates, environmental and sanitary instruments to the personnel listed in the register through a previous tender. This regulation was codified in Decree N°15 (Chilean National Congress Library, 2011a).

The certification and sanitary requirements for the import of hydrobiological species was regulated to prevent the entry of diseases and causal agents via importing aquatic species, eggs or gametes, especially those that were not present in the national territory or diseases that had a specific surveillance or eradication programme in the country. It established a risk analysis of the hydrobiological species, eggs or gametes to be exported to Chile. Based on this analysis Sernapesca would issue a list of the countries from where hydrobiological species, eggs or gametes can be imported to Chile. The import of hydrobiological species, eggs and gametes requires sanitary certificates issued by the competent authority of the origin country that meet the requirements set in this regulation. This regulation also refers to the procedure to import hydrobiological species and is codified in Decree N°72 (Chilean National Congress Library, 2012a).

In 2012 the Sanitary Programme on Mortality Management was created by Resolution N°1468 (Chilean National Congress Library, 2012d) with the aim of establishing procedures to prevent the dissemination of pathogen agents, and reinforce vigilance for the early detection of high risk diseases during the mortality management produced in the farming centres. The programme established the classification and reporting of mortalities to the authority, the procedures to extract and manage the mortalities including the disinfection, denaturation and removal of mortality. The programme issued regulations for embarking and disembarking points (ports) for the farming of salmon species, setting the health management conditions for the points intended for the loading and unloading of fish and materials used in the cultivation of salmon activities. This was codified in Resolution N°2323 (Chilean National Congress Library, 2011q).

Complementing the measures proposed by Sernapesca, in 2009-2010 SalmonChile developed 44 voluntary specific sanitary measures. Out of these 44 measures, 20 were not norms dictated by Sernapesca, however, the Association considered they were crucial for adequate sanitary management. Among these measures were restrictions on the movement of broodstock in the sea, the prohibition of spawning in marine sites, the complete cycle of eggs on land and vaccination before placement in lakes (Barros, 2010).

During the recovery stage, the bureaucrats of Subpesca and Sernapesca continued to provide permanent information about the set of regulations developed due to ISA. This included the publication of maps of macrozones and groups of concessions, information about caligus in the macrozones, and the future publication of the score of sanitary risk. This information was provided via their websites, workshops and meeting with the addressees and other relevant stakeholders.

In the development of the measures to deal with ISA, the neoliberal coalition had a very active participation meeting and lobbied the Salmon Roundtable and authorities. By contrast, the ecological coalition was less active in proposing measures, and its participation was more focused on discussing and contesting the measures developed by the neoliberal coalition.

To support the recovery phase, involving the development of further regulation and adjustment of existing instruments, the government formed two advisory groups: an Expert Panel and a second Salmon Roundtable. The Expert Panel was an advisory group for aquaculture formed in the first trimester of 2011 with the aim of complementing the technical-sanitary view of the authority with opinions on economic and social effects of sanitary and productive measures. The Panel was asked to give expert advice on three issues. The first was the measures concerning the smoltification of Atlantic salmon, Coho salmon and trout in rivers, lakes and estuaries. Since it was proposed, this had been a conflicting issue dividing the industry. The basic question was whether it was possible to produce smolts in rivers, lakes and estuaries. This measure had sanitary and operating cost impacts.

The second issue was the controversial instrument of macrozones in Los Lagos, Aysén and Magallanes Regions and the features of corridors between these macrozones.

The last issue was regarding a methodology and/or mechanism to evaluate and classify the risk of farming centres and group of concessions via a 'risk score'. The idea was to establish a methodology, variables, criteria and scales to establish scores of sanitary risk. This score would be public through the Sernapesca website in order to 'discipline' the firms in sanitary terms. This score could be also useful to make decisions such as financing and sanitary control from Sernapesca (Estrategia.cl, 2011; Subpesca and Fundación Chile, 2011).

The formation of this Panel received some criticism as was exemplified by an interviewed researcher who was sceptical about the capabilities of the 'experts' in making decisions. The researcher explained that, in the composition of the Panel, three economists and one veterinary (or as the researcher pointed out 'a cow epidemiologist'), there was no one who knew about salmon but they would be responsible for making decisions about salmon.

In August 2011, as reported by Aqua, the government, through the Ministry of Economy, reinstated the Salmon Roundtable to provide support to the aquaculture sector, analyse relevant issues, propose solutions and support the salmon industry in its recovery. This Roundtable had a different organisation and dynamic from the first Roundtable formed in 2008. It was organised in five working groups (institutions, territorial organisation, production model, infrastructure and science and research) composed of salmon producer firms and coordinated by a bureaucrat from Subpesca, Sernapesca or Ministry of Economy. Each group met independently and frequently and could decide whether other relevant actors should be invited to participate in the group. The five groups also met together frequently.

Among the themes to be considered by the Roundtable were the institutions of the sector, the growth and development of the industry, how to produce and the relocation of concessions. The results of the Salmon Roundtable's work were expected to be delivered by December 2011 (Aqua.cl, 2011a; Aqua.cl, 2011f; Aqua.cl, 2011e).

In an interview with Aqua, the President of Acotruch (Association of Coho Salmon and Rainbow Trout Producers) said that the Association valued the invitation and opportunity to participate in this second Roundtable. He said that in the first Roundtable most of the producers and many firms were excluded and their opinions were not heard. Also he pointed out that, unfortunately, they did not participate nor were not heard by the first Roundtable, but now they had the opportunity to actively work in the discussions of relevant issues for the future of the industry (Aqua.cl, 2011a; Aqua.cl, 2011f; Aqua.cl, 2011e).

Thus, there was a belief that the second Salmon Roundtable was more inclusive. In an interview with Aqua, the Undersecretary of Fisheries explained that this Roundtable would work with all the relevant public stakeholders and six representatives of the private sector in each of the five formed working groups. In the first stage of the Roundtable only producers of sea salmon and sea trout were considered, however, it was intended to expand the participation and to include all those who were able to participate (Aqua.cl, 2011e).

As reported by Aqua, the strategy of Acotruch was to ask the authority if one or two representatives of the Association could participate in each group, and in this way to ensure an active participation and voice in all the working groups. Acotruch also pointed out to the authority the need to consider the voice of various actors involved in the salmon activity in the enactment of regulations before these are passed. According to the Association, in this way it was ensured that the regulations affecting the industry had greater stability over time, and in this way avoid constant changes that create uncertainty for investors (Aqua.cl, 2011e).

In August 2012 the Aquaculture National Commission was created by Law N°20597 (Chilean National Congress Library, 2012b) to advise the Chilean President through the Ministry of Economy, Development and Tourism on the implementation of the National Aquaculture Policy, and in September 2013 the Aquaculture Scientific-Technical Committees were implemented. The proposal was to have three Scientific-Technical Committees: one for environmental issues, another for sanitary issues, and the third for the territories. These committees would be consulted about scientific topics relevant for the administration of aquaculture. Also they could be consulted on the methodology for classifying farms and groups of concessions, proposals for the establishment of macrozones, and the evaluation of sanitary programmes. The members would be selected through a public competition held by the Ministry of Economy according to Decree N°77 (Chilean National Congress Library, 2011f) (Aqua.cl, 2013k).

In terms of government reorganisation there was a structural organisational change in the Undersecretary of Fisheries (Subpesca) and in the Fisheries Service (Sernapesca). In August 2012 both organisations changed their names to the Undersecretary of Fisheries and *Aquiculture*, and Fisheries and *Aquaculture* Services respectively. Also the Undersecretary of Fisheries and *Aquiculture* created the Aquiculture Division to reinforce the importance of the aquaculture sector, and give explicitly the same hierarchy for aquaculture and fisheries. Among its responsibilities, this new division had the organisation of the territory for aquaculture and the proposal of sanitary measures. In the same line the Fisheries and *Aquaculture* Services created the Aquiculture Unit. All this was made by Law N°20597 (Chilean National Congress Library, 2012b) (Aqua, 6 August 2012; Aqua, 13 August 2012).

The following table summarises the long-term policy responses to the sanitary crisis analysed in this section.

Table 6.3: Long-term responses

Instruments Taxonomy		
Nodality or information-based instruments	Public information campaigns	- Workshops and meetings from Subpesca and Sernapesca - Score of sanitary risk through Sernapesca website - Publication of maps of macrozones, maps of group of concessions, caligus and set of regulations through Subpesca and Sernapesca websites - ISA outbreaks and state of farming centres and zones (e.g. surveillance, quarantine)
Authority-based policy instruments	Command-and-control-regulation	- HMAs regulations (Resolutions N°1896, N°2238, N°1548 and N°1549) - Sanitary Programme ISA (Resolution N°1577) - Specific surveillance and control sanitary programme (Resolution N°1141) - Regulation on fish density (Sernapesca, 2012) - Record of personnel to make environmental and sanitary instruments (Decree N°15) - Certification and sanitary requirements for import of hydrobiological species (Decree N°72) - Sanitary programme on mortality management (Resolution N°1468) - Sanitary conditions in biosecurity embarking and disembarking ports (Resolution N°2323) - Modification of GLFA (Law N°18892) - Modifications of RESA (Decrees N°416 and N°349) - Modifications of RAMA (Decrees N°397 and N°350) - HMAs regulation adjustments (Resolution N°2273) - HMAs regulation adjustments (Resolutions N°1739, N°1897, N°1898, N°2256, N°756, N°1215, N°1381, N°2253, N°2082, N°2891, N°2302, N°3104, N°2534, N°2003 and N°2435) - Modification of concessions (Decree N°202) - Modification of automatic positioning of ships regulation (Decree N°198) - Modifications of RESA (Resolution N°275 and Decree N°56) - Modifications of RAMA (Decree N°168) - Modification of ISA Sanitary Programme (Resolution N°228) - Modification of regulation on sanitary conditions in biosecurity embarking and disembarking ports (Resolution N°302) - Specific Sanitary Surveillance and Control Programme Caligus (Resolution N°2117) - Modification of the Specific Sanitary Surveillance and Control Programme Caligus (Resolution N°1141)
	Self-regulation	44 measures of SalmonChile
	Advisory committees	- Expert Panel - Salmon Roundtable (second one) with five working groups - Aquaculture National Commission (Law N°20597) - Scientific-Technical Committees on Aquaculture with three working groups (Decree N°77)
Organisation-based policy instruments	Government (re)organisations	- Adjustment of Sernapesca and Subpesca organisational names to include Aquaculture - Creation of Aquiculture Division in Subpesca - Creation of Aquiculture Unit in Sernapesca

Source: Own elaboration based on analysis, Hall (1993) and Howlett, Ramesh and Perl (2009).as theoretical base.

In summary, the initial crisis had not produced a paradigm shift in either government or industry from a neoliberal to an ecological one. However, it was a sufficient condition to produce a fundamental change in the production model of the industry, changing the goal of the production model from uncoordinated production to coordinated production. The HMA model in the Chilean context was taken as the best practice to control the virus: it was proposed under the premises of a neoliberal paradigm. However, although it was not thought or explicitly recognised at the beginning as a motive and after some experience and evidence had accumulated, the model revealed elements of an ecological paradigm. These elements were observed in practice after the implementation of the model and stated to be crucial to deal with the virus.

The fundamental change in the industry's production model, and the unchanged paradigm, is explained below using the characteristics of a policy regime change proposed by Howlett, Ramesh and Perl (2009) and summarised in Table 6.4:

1. Regime stability: the firm neoliberal policy paradigm and a convenient uncoordinated production model

The neoliberal policy paradigm was institutionalised in Chile in the 1970s by the military coup and the group of economists called pejoratively the 'Chicago Boys', which advised in favour of a radical change toward neoliberal fiscal and monetary policies. Within its achievements are the development of an export-oriented model and natural resource based industries such as the salmon farming industry. A key characteristic of the paradigm was the deregulation of sectors that wanted to be developed.

The regulatory framework of the salmon industry prior the crisis, framed in the neoliberal paradigm, allowed the fast growth and rapid insertion of the industry into the global economy. This regulatory framework was characterised by an aquaculture concession scheme that stimulated an intensive model of production and a free production approach with unrestricted density of fish per cages, farms and concessions from the state to the private sector. Adjustments to the industry's regulatory framework were made in the 2000s (development of RESA and RAMA) by members who shared the principles of the neoliberal paradigm.

The common-pool resource water was individually managed by each firm without coordination with others. Thus, the placement of smolts into the seawater, sanitary fish treatments and all salmon activities were freely made according to the needs of each firm. The uncoordinated method of industry production was something that implicitly facilitated the rapid success of this young industry. Without coordination costs, the industry easily achieved a continuous growing production, which led the industry to rank as the second global salmon producer and exporter of salmon species after Norway.

2. Accumulation of real world anomalies: the ISA sanitary crisis as the anomaly for the neoliberal policy paradigm and the uncoordinated production model

The sanitary crisis was a serious anomaly for both the neoliberal policy paradigm and the uncoordinated production model. The deregulation dictated by the paradigm, and its conceptualisation of rapid development as requiring un-regulated or self-regulated control, meant that the regulatory framework prior to the crisis did not include specific regulation to deal with ISA (even when both the industry and authorities were aware of this virus and its negative effects in other salmon-producer countries). The paradigm relied on the self-interest of producers to prevent such a crisis. The paradigm was focused on economic criteria, but the sanitary crisis was an ecological problem for the industry with economic and social consequences. Short term opportunism prevailed over rational self-interest defeating self-regulation that, in other contexts, might be effective because of the more direct evidence of responsibility and more direct measures for control. Because of this, and since ISA was a different problem from what the regulatory framework was familiar with, the regulatory framework prior to the crisis could not solve the sanitary crisis and its effects itself.

Expert advice and the international experience of those countries that already dealt with ISA (see section 3.2) showed that coordinated management of sanitary treatments and biosecurity measures are crucial measures to deal with and control the virus. The transportation of smolts from different suppliers, and contact with contaminated equipment or equipment by people handling infected fish from farm to farm, have been suggested as mechanisms of transmission. All these activities need to be coordinated over the whole industry to stop the spread of the virus and control it. However, the uncoordinated way in which the industry was operating could not offer adequate solutions to deal with the virus.

3. Experimentation: incapacity of stretching the neoliberal policy paradigm and the uncoordinated production model

The existing policies of the regulatory framework prior to the crisis could not be adjusted to deal with ISA since the measures suggested by international experience were very specific and were not included in existing Chilean regulations. Since there was no legal ground to deal with ISA there was no experimentation in regulatory terms. Instead of experimentation there was a process of regulatory development that included a set of regulations and programmes to control the virus. The only way in which the existing regulatory framework could be stretched was in that the authority explicitly enforced the existing regulations about cleaning and disinfection.

The uncoordinated production model could not help in dealing with and controlling the virus since international experience showed that, actually, a coordinated management of farms was needed. There was no experimentation with the production model and the efforts were focused on developing a new production model with the coordination of measures and farm management that later on became the HMA model.

4. Fragmentation of authority: the stable policy subsystem and the discredited individualistic approach of the production model

Interest groups such as environmental and labour NGOs, associations of service suppliers, artisanal fishermen and researchers, challenged the existing subsystem in terms of their approach in developing the aquaculture sector and the salmon industry. The existing subsystem, including the government and the aquaculture authorities Sernapesca and Subpesca, were discredited and strongly criticised by the scope of their role. However, this criticism did not result in fragmentation of authority and the existing subsystem kept its power and positions in decision making. Experts and officials in power worked on the solutions to solve the crisis, and other actors such as NGOs were only marginally included through the expression of their points of view, but excluded from the decision making process.

Using international expert advice, the existing subsystem developed the set of regulations and programmes needed to control the virus and actively worked on the modification of the GLFA. On the other hand, the individualistic approach of the production model had already been shown to be ineffective, and that the industry model needed a profound change and adjustment in its goal.

5. Contestation: the debates on the neoliberal policy paradigm and the uncoordinated production model

Contestation between the neoliberal and the ecological coalitions were made in the form of criticisms, denunciations, participation in meetings with the Salmon Roundtable, campaigns and strikes. The efforts of some actors of the ecological coalition were focused on criticising the proposed measures and the modifications in the GLFA made by the neoliberal coalition in order to include some elements of the ecological paradigm. Inside the neoliberal coalition actors were contesting the settings of the HMA model (e.g. period of fallow), however, they agreed with the content of the proposal and the modification of the law. There was no contest regarding the uncoordinated production model since, at this point, it was already understood that the industry model should significantly change.

6. Institutionalisation of a new regime: the reaffirmation of the neoliberal paradigm and the institutionalisation of coordinated production

Advocates of the ecological paradigm did not secure positions of authority, and therefore there was no alteration of the decision making process in order to institutionalise an ecological paradigm. Members of the existing paradigm reaffirmed their positions and with this there was a reaffirmation of the neoliberal paradigm. However, the reaffirmed neoliberal paradigm exhibited some incipient elements of an ecological paradigm. Some of these elements were embedded in the industry's new production model, such as the awareness of biosecurity measures and more protection for the environment through fallow periods, and some of them were embedded in the content of subsequent measures. These ecological elements were incorporated with the aim of ensuring a continuous growing production and being able to compete at the global level. The rhetoric of the paradigm remained the same but the content of the measures (e.g. HMA model and the measures that followed this model) reflected an increasing influence of the ecological paradigm; ecological issues are seen as a means to retain the neoliberal paradigm.

The industry discourse about the importance of the industry for the country and the southern regions in terms of economic development and jobs, and the extension of the industry to Magallanes, was presented as a new opportunity for the industry to develop another southern region and provide jobs, but now 'in the right way' with a new production model (i.e. HMA model). This could be interpreted again as the regulatory capture of the government from the industry.

Regarding the industry policy paradigm shift from the neoliberal to the ecological, we conclude that the ISA crisis was a sufficient anomaly to disrupt the existing industry regulatory framework. This disruption opened a window of opportunity to provoke a process of policy paradigm change, however, this change in the policy paradigm did not occur. Although there was contestation from the ecological coalition, the goal of the ecological paradigm was well established, and the impossibility of stretching the existing neoliberal policy paradigm was sufficient evidence of the need for change.

Neither the public regulators nor the private sector actors of the Chilean salmon industry experienced a policy paradigm change from neoliberalism to environmentalism. A primary reason for this, consistent with Hall's discussion on paradigm shift, was that there was no fragmentation of authority in the policy subsystem based on the neoliberal paradigm that would have occurred had members of the ecological coalition secured positions with the aim of altering the existing decision making.

On the other hand, two pieces of evidence allowed for the fundamental change in the industry's production model from uncoordinated production to coordinated production. First, there was enough evidence showing the ineffectiveness of uncoordinated production in the Chilean industry. International experience from other countries that already had ISA effectively showed that coordinated management was crucial to solve events such as ISA. Since those countries had already proved the model, there was assurance for the Chilean industry that what worked in other industry would work for the Chilean one.

In these other contexts, there was fragmented authority and representatives of the ecological paradigm were present. As a result, the policies imported from these areas embedded ideas drawn from the ecological paradigm. However, they were conceived by the importers (Chilean policymakers) as being consistent with international competitiveness, which allowed these policymakers to ignore the origins or process of these policies' creation.

Second, the industry's new production model, based on the HMA model, was strongly defended by, although fragmented, an articulated formal coalition. Even more, the fragmentation of the Association of Salmon Industry and the formation of a new Association of Coho Salmon and Rainbow Trout Producers (Acotruch by its Spanish acronym), in the end strengthened the neoliberal paradigm. This was because two different associations of producers were defending a change in the production model and it was reaffirmed that the proposed model was the right one, although some adjustments in the settings of the model were needed (Chapter 7 will analyse this issue). In this way, the fundamental change in the industry's production model supported the reaffirmation of the reigning neoliberal paradigm.

The implication of this is that even when industries experience great shocks such as crises in their policy environment, this may not be sufficient condition to produce a policy paradigm shift (Sabatier, 1988). However, crises such as ISA may trigger processes of policy learning and give the opportunity for great policy change or paradigm shift driven by the features of the crisis' stages and the conflict among actors. A policy paradigm shift requires the existence of an articulated framework including formal and non-fragmented coalitions to compete and break the existing dominant paradigm.

If there is no policy paradigm shift, changes in policies provoked by great shocks may exhibit notions of the alternative paradigm (i.e. a paradigm challenging the dominant one), when contesting coalitions succeed in including elements of the alternative paradigm in the policies. In the case of the salmon industry, the reaffirmed neoliberal policy paradigm of the industry exhibits incipient elements of an ecological paradigm since the ecological coalition could include some elements in the new policies. This suggests that the ecological paradigm will have another opportunity for great policy change when the policy window is open again with the next ecological crisis, or when members of the ecological coalition secure positions in decision making processes.

Table 6.4: Regime change in policy paradigm versus production model

Characteristics of policy regime change	**No shift in the policy paradigm (from neoliberalism to environmentalism)**	**Fundamental change in the production model (from uncoordinated production to coordinated production)**
Regime stability: the firm neoliberal policy paradigm and a convenient uncoordinated production model	Neoliberalism was institutionalised in the 1970s. Deregulation of the industry allowed for fast growth and rapid insertion into the global economy.	Uncoordinated production model of the industry facilitated rapid success and development of the industry.
Accumulation of real world anomalies: the ISA sanitary crisis as the anomaly for the neoliberal policy paradigm and the uncoordinated production model	ISA as a serious anomaly for the neoliberal policy paradigm. Ecological problem for a neoliberal paradigm.	ISA as serious anomaly for the uncoordinated production model.
Experimentation: incapacity of stretching the neoliberal policy paradigm and the uncoordinated production model	No experimentation in policies but the development of specific regulation for ISA.	International experience showed that coordinated management is needed.
Fragmentation of authority: the stable policy subsystem and the discredited individualistic approach of the production model	Existing subsystem challenged by interest groups but no fragmentation of authority occurred.	Individualistic approach of the production model discredited and the need for a profound change of it.
Contestation: the debates on the neoliberal policy paradigm and the uncoordinated production model	Contestation from ecological coalition to the neoliberal paradigm, but no alternative proposed to the solutions proposed by the neoliberal coalition.	No contestation regarding the uncoordinated production model.
Institutionalisation of a new regime: the reaffirmation of the neoliberal paradigm and the institutionalisation of coordinated production	Reaffirmation of the neoliberal regime. It is reaffirmed that the industry is a key sector for Chile, especially the southern regions. There is an opportunity to bring development to Magallanes (Region XII). The extension of the industry is seen as an opportunity for development for a southern region.	Institutionalisation of the HMA model through its effectiveness in other salmon industries, defence of the model from an articulated coalition and political support from the government.

Source: Own elaboration based on analysis and using Howlett, Ramesh and Perl (2009) as theoretical base.

6.4. Synthesis of the chapter

In the Chilean salmon farming industry the policy responded to the sanitary crisis following its evolutionary stages. No policy was preventively developed to deal with ISA in a pre-event stage of the crisis, and the responses were developed and delivered in three different phases. The immediate responses were developed and applied during the stabilisation stage of the crisis, as discussed in Chapter 5. The short-term policy responses were developed and applied during the normalisation stage, and long-term responses were developed and applied during the improvement, adjustment and restoration stages of the crisis.

During the first stages of the crisis the short-term responses were mainly a new set of policies oriented to the detection and control of the virus in order to stop the salmon mortalities (i.e. to address the first policy problem). The urgency, non-routine responses required to address the unusual problems the industry was experiencing, and the rapid mobilisation of actors, meant that these responses were potentially radical in causing a policy paradigm shift in the industry that could be observed after their implementation and when some experience and evidence was accumulated.

Since it was the first time that ISAv was present in Chile in its clinical presentation in Atlantic salmon, the country did not have the knowledge or experience to know how to deal with the virus and solve its sanitary effects. Knowledge and experience from countries that experienced ISA crises before Chile, such as Norway and Canada, were then used to design the responses to the crisis in the local context. Within this new set of policies, the most potentially radical change in the industry came in 2008 with the development and implementation of the Health Management Area Model. This model was the only alternative proposed as a new form of industry organisation and constituted a fundamental change in the production of salmon in Chile. Proposed by the neoliberal coalition, and following a policy transfer process, the model was inspired by the Canadian Bay Management Area Model, experience that showed that coordinated management of farms was a crucial measure to control the virus. With this new production model all the measures already developed would be more effective because the model would organise the farming centres in a more effective way to ensure production.

The adopted solutions to the crisis were framed within the neoliberal paradigm of restoring levels of salmon production. During the later stages of the crisis the long-term responses mainly addressed the second policy problem (i.e. to update the industry regulatory framework including the development and implementation of new policies and the modification of existing instruments), but also they were aimed at continuing with the control and spread of ISA (i.e. first policy problem). The improvement and adjustment of policy instruments was made by incremental policy changes that revealed an increasing degree of the ecological paradigm in the new production model of the industry.

The main regulatory change in the industry came with the process of reform of the 1989 GLFA, with the aim of incorporating a preventive problem-solving approach and institutionalise the new production model of the industry. This policy reform process was, in general, a participatory one but, as reported by interviewees, some actors such as Coho salmon and trout producers, environmental NGOs and suppliers, were dismissed, and disagreements on the proposed measures and favouritism to some actors (e.g. Atlantic salmon producers) destabilised the consensus that the industry had before the crisis. This implied that conflict and ambiguity over the industry policy learning were present, as will be seen in the next chapter.

The ISA crisis was a sufficient anomaly to disrupt the existing industry regulatory framework and this disruption opened a window of opportunity to provoke a process of policy paradigm shift from the neoliberal paradigm to an ecological one; however, this paradigm shift did not occur. A primary reason for this is that there was no fragmentation of authority in the policy subsystem making decisions, and members of the ecological coalition did not secure positions with the aim of altering the existing decision making. Instead, the ISA crisis provoked a fundamental change in the industry's production model, changing the goal of the production model from uncoordinated production to coordinated production.

This fundamental change was possible because there was enough international experience and evidence showing the ineffectiveness of the uncoordinated production in controlling the virus, and because the HMA model was strongly defended by, although fragmented, an articulated formal neoliberal coalition. The fragmentation of the neoliberal coalition strengthened the neoliberal paradigm since different actors were defending a change in the production model. The fundamental change in the industry's production model supported the reaffirmation of the reigning neoliberal paradigm. However, although it was not thought or explicitly recognised at the beginning as a motive and after some experience and evidence had accumulated, the model revealed elements of an ecological paradigm. These elements were observed in practice after its implementation and stated to be crucial to deal with the virus. Thus, the reaffirmed neoliberal policy paradigm in the Chilean salmon industry exhibits incipient elements of an ecological paradigm.

CHAPTER 7

CONSEQUENCES OF POLICY RESPONSE TO THE SANITARY CRISIS IN THE CHILEAN SALMON FARMING INDUSTRY

"[In the modifications of the law and sanitary regulation] there were many things that were left out and other things that were misplaced. They are not easy to implement and often not practicable for both the authority [bureaucrat] and the producers [addressees]"
(An interviewed Bureaucrat)

This chapter analyses the consequences of the policy responses to the sanitary crisis in the Chilean salmon farming industry. The analysis is made from a conflict and ambiguity policy perspective, adapted from Matland (1995) and Slembeck (1997), which combines political and technical elements allowing a further analysis of policy learning. This perspective is relevant since policy learning is not a neutral process based solely on the role of ideas and knowledge in policy but one strongly influenced by the power relationships among actors. In this perspective both conflict and ambiguity in policy have diverse sources and, depending on their intensity (low or high), lead to different types of consequences (consequences with low conflict and low ambiguity, consequences with high conflict and low ambiguity, consequences with low conflict and high ambiguity, and consequences with high conflict and high ambiguity).

The analysis is made highlighting three themes: i) the increasing influence of the ecological paradigm on the industry policy learning and policy change, ii) the reconfiguration of actor interests and the influence of Acotruch over policy issues regarding production, and iii) the consequences of the policy responses and new regulations on the structure of the industry.

The chapter begins with the role that conflict and ambiguity played in the policy learning of the Chilean salmon industry. Then, taking forward this idea, it turns to the second section about the short-term consequences from the policy response to the sanitary crisis in the industry. The short-term consequences involve the conflict and ambiguity in the design of the policy responses, and the conflict and ambiguity in putting the policy responses into practice. The third section discusses the long-term consequences from the policy response with the adjustments made on the policy instruments towards reducing their conflict and ambiguity. The fourth section refers to the evidence of policy learning and policy change from the ISA crisis. The chapter ends with the closing of the policy window, and information about the recovery of the Chilean industry that has the status of a country with endemic ISA, like the other global salmon producers.

7.1. The role of conflict and ambiguity in the industry policy learning and policy change of the Chilean salmon industry

In the Chilean salmon farming industry conflict over policy issues emerged due to the incompatibility of policy goals, interests, values and activities among actors, as well as their disagreements over policy means and policy outcomes. The restriction on the behaviour of the industry actors also led to conflict with the government and bureaucrats. Ambiguity in the industry emerged due to misunderstandings or uncertainty about policy goals, policy instruments and the settings of the policy instruments that the different actors had over policy issues. Also when the actors interpreted the goals or instruments of policy differently, there were misunderstandings or uncertainties in their role, uncertainties in their capability or capacity and resources to reach policy goals or implement policy instruments, or when there was ambiguity in the language of policy. These observations are consistent with the studies of Matland (1995) and Slembeck (1997) who discuss the role of conflict and ambiguity in policy implementation.

In the Chilean industry it was clearly observable that there was conflict and ambiguity not only between the ecological and neoliberal coalitions but also within the neoliberal coalition, as will be seen in the next sections. Both the conflict and the ambiguity concerning policy issues in the industry had different sources and they evolved over time over the phases of the sanitary crisis. This evolution was due to the change in the knowledge, interests and values of actors regarding policy problems, alternatives and outcomes. We employ the conflict and ambiguity matrix developed in Chapter 2, which arrays consequences in a 2x2 matrix with conflict and ambiguity as axis and high and low levels. This conflict and ambiguity approach allows the identification of four distinct types of policy consequences that evolved over time, as discussed in the next sections.

7.2. Short-term consequences of policy response to the sanitary crisis

The short-term consequences of the policy responses are those related to the immediate and short-term policy responses that occurred during the stabilisation and normalisation stages of the crisis (i.e. reaction phase). There were two consequences from the short-term policy response adopted by the industry: the conflict and ambiguity caused in the process of the design of the immediate and short-term policy responses, and the conflict and ambiguity in putting those policy responses into practice.

7.2.1. Conflict and ambiguity in the design of the policy responses

The virus and the problems caused by it were new for the Chilean industry and, as said previously, rapid and new measures were developed to face those problems and control the virus. In general, during the design of the immediate and short-term measures in the industry, the conflict and ambiguity over policy issues were present with different intensities. The most controversial response was the proposal of a new industry production model based on the HMAs. This model constituted a fundamental change for the industry, and its potential to be a radical measure meant that conflict and ambiguity occurred with respect to different aspects of the model. Both the conflict and ambiguity had different intensities, as is explained below.

High conflict and low ambiguity:

One of the most controversial aspects of the HMA model, that started to show the influence of Acotruch over policy issues related to production, was the fixed three month fallow period measure for all salmon species. Coho salmon and Trout Producers strongly opposed this measure arguing that this fallow period did not represent their interests because it was detrimental to the production of species other than Atlantic salmon, such as trout and Coho salmon, species that have a production cycle distinct from Atlantic salmon and are not affected by ISA virus. In their opinion there was *favouritism to Atlantic salmon* since the majority of the regulation related to the HMAs was just in favour of the production of that specie and prejudicial to the production of Coho salmon and trout (Aqua.cl, 2009d).

The banking sector also explicitly expressed their interests requiring assurance in the concessions as collateral. As a Claro y Asociados (2009) points out, banks were concerned that these assets may disappear over time for reasons for which they were not responsible, for example, the concession holder failing to take on required labour or other reasons for lack of operation of the concession, as well as possible negative results of the INFAs or non-payment of concession fees.

Interest groups, such as artisanal fishermen and some environmental NGOs, strongly disagreed with the possibility of the private sector being allowed to offer concessions as collateral to the banking sector in order to renegotiate its debts and get money. This revitalised the ideological discussion about the ‘privatisation of the sea’. As a Congressman explained, although the aquaculture concessions existed from long ago, this new law’s provision that they would be used as collateral gave a judicial status to the firms. They would be able to get credits in order to perform the productive and sanitary innovations that the industry was not able to do in the boom of its development (Chilean National Congress Library, 2010d). However, the majority of interviewees agreed that the so-called 'privatisation of the sea' had already occurred with the initial law prior to crisis (Law N° 18892).

Two aspects of the model that had low ambiguity but high conflict and affected the structure of the industry, were the belief that the creation of the HMAs privileged larger firms over smaller ones and the changes made in the *concession scheme*. A representative of a producer firm explained that there was some *favouritism to larger firms* since HMAs would fallow at a certain point in time; larger and diversified firms, firms with concessions in different HMAs or with the possibility of renting concessions, might be able to ensure a continuous production. When some of their concessions were fallowing, they could use other concessions in other HMAs that were still in operation. Smaller firms with few concessions, or with all of their concessions in just one HMA, could not produce when that area was fallowing.

This situation is incompatible with the production possibilities of smaller firms and threatens their survival. In the words of the interviewed representative, the HMAs system, in the end, allowed for the survival of diversified firms (firms in different HMAs) and not those with few concessions. Therefore there were advantages for large firms. On the other hand, the change of the period to operate the concessions, from an indefinite period to 25 renewable years, was strongly criticised mainly by the interviewed producer firms who thought that this change in the rules of the game created disincentives for new investments and the production business.

Low conflict and high ambiguity:

The increasing influence of the ecological paradigm in the design of the HMA model (proposal framed in a neoliberal view) introduced high ambiguity over several aspects of the model. An issue that was highly questioned was the *scientific base of the model*. It was argued by the majority of interviewees that there was a lack of scientific knowledge to explain the design of the HMAs. This created uncertainty over the scientific rationale of how the HMAs were formed, their number and the distance between concessions inside the areas and the areas among the macro zones. Argued by interviewees, oceanographic studies (e.g. direction of the currents and its effects on farming centres according to their location) and studies on load capacity of the ecosystems were not taken into account. This knowledge is crucial to the design of an effective model. As an interviewed consultant explained, it is fiction to think that the HMAs somehow represent an homogenous environmental reality and that they are areas distinguishable from each other. There are many HMAs but their limits have a lack of scientific information to support the fact that one area is different from another. If differentiated managements are made in areas that actually are not different it is possible to make severe mistakes.

Related to the above issue, the *environmental and sanitary effectiveness of the HMAs* was also highly questioned by some NGOs. They argued that it was not clear whether the HMAs were adequate to address environmental and sanitary problems or externalities caused by salmon activities to the ecosystem. For example, as an interviewed NGO explained, the main principle of the model was the coordinated operation of farming centres, and therefore, when the farming centres applied coordinated sanitary treatments, they would do it at the same time and all the effects of the medicaments would be released into the environment.

Some interviewees questioned *some practices to be adopted*, for example, the management of broodstock on land rather than at sea, compulsory vaccination, and effluent treatment in aquaculture systems. They argued that these measures implied great investments without assurance of their effectiveness, and that these types of drastic measures needed a period of learning before being enforced. An interviewed researcher explained that since virus mutate and vaccines are made using biological material from previous years, the effectiveness of those vaccines may be lower than expected. On the other hand, a representative from a producer firm pointed out that they sent letters to Sernapesca and Subpesca expressing their discontent on avoiding broodstocks at sea, saying that 'any transition from one system to another requires a learning process...one can generate significant restrictions but it is very risky to make drastic changes without a validation process which guarantees that you will not have problems because you may cause a non-sanitary crisis'.

High conflict and high ambiguity:

During the design of the new model for the industry, two issues with high conflict and ambiguity that affected the structure of the industry were the *production in lakes, estuaries and rivers,* and the *relocation of concessions*. Disallowing the production of smolts in lakes, estuaries and rivers proposed a change in the reproduction of fish from fresh water to other facilities such as in land facilities. However, it also showed how the interests of Acotruch were affected. According to interviewed Coho salmon and trout producers, the measures to disallow the production of smolt in lakes, estuaries and rivers as a sanitary measure to avoid ISA during the fresh water phase were unsatisfactory, especially for Coho salmon and trout producers who thought that the government was revoking the opportunity to produce at a lower cost. Since trout and Coho salmon do not develop ISA they argued that these species can be produced in lakes, estuaries and rivers without problems. According to them, lakes, rivers and estuaries are an important part of the competitive advantages of Chile in salmon production. However, since trout and Coho salmon may act as reservoirs of ISA, it was not clear to the authorities if the smolt production of these species in lakes, estuaries and rivers would maintain ISA in the fresh water phase.

The relocation of concessions meant that concessions might be found in unsuitable places according to the HMA model, and they should be moved to other more suitable places. This implied a geographical change in the production of salmon. It was not clear how the relocation of concessions could be done in practice in order to create corridors that would act as firewalls among HMAs and macrozones. Concessions located in these corridors were subject to be relocated. As a consultant said 'to my knowledge, I do not know if anyone has calculated a study of winds, currents and tides and what are the corridors that are required. A corridor is not just distance, we need information on currents'. Again, there is uncertainty and lack of information on studies of tides and winds to design the model.

On the other hand, NGOs disagreed to the possibility to relocate concessions in other regions and in this way to extend the industry to the south. Reported by the media, decisions about the corridors would require more time since there was no available oceanographic information, which is crucial in the design of maps of macrozones. Producers pointed out that more conclusive studies were needed in order to define the maps of the macrozones and that the first available map would not be definitive (Aqua.cl, 2011b).

A very important consequence of the conflict and ambiguity regarding the design of the HMA model was a crisis inside the Association of Salmon Industry (SalmonChile), with the consequence of two important breakdowns that ended in AquaChile (the largest Chilean capital firm) leaving the SalmonChile Association and its board (Víctor Hugo Puchi who is the president of AquaChile resigned as the vice-chairman of SalmonChile). Some trout and Coho salmon producers also left; they created a new association to defend their interests, the Coho salmon and Rainbow Trout Producers Association (Acotruch).

The interests, decisions and measures adopted by the Association of Chilean Salmon Industry (SalmonChile) did not represent the interests of AquaChile and those trout and Coho salmon producers. According to reports from Aqua, inside SalmonChile there was consensus on the modification of the GLFA and some industry practices to improve the sanitary standards of the industry. However, there were opposite views about how to face those modifications. The strongest disagreement was on the minimum distance between concessions. For Víctor Hugo Puchi this distance should be 3.2Km, but for other firms it should be no more than 2Km. So, the firm disagreed in the distance of farming centres proposed by the Association. The more distance between centres the fewer concessions could be granted.

This fact opened polemics about whether the actual concern defining a minimum distance between centres was to reduce the likelihood for fish disease spreading or to increase the value of concessions and then restrict activities for those firms with fewer concessions. AquaChile is the largest Chilean firm with the majority of concessions in the industry (about 150). Smaller firms (firms with fewer concessions) inevitably need more concessions for growth. When the Board of the Salmon Industry Association voted for the minimum distance, the votes were divided but the 2Km proposal won. The 2Km was the distance that Subpesca took into account to include in the HMA model. The smaller firms (the majority in the Association) voted in favour of 2 Km. At that time on the board of the Association one firm represented one vote independent of the firm size (Aqua.cl, 2010e; Aqua.cl, 2010d). The subject to vote of scientific facts is more evidence of the neoliberal view on the HMA model.

The other disagreement was that AquaChile (Víctor Hugo Puchi) thought the Association was demanding measures for the industry that were too soft. People from the sector opined that Puchi's view was a technical one in the long-term but the Association's view was a short-term view (Aqua.cl, 2010d). Puchi's long-term view can be interpreted as attempting to be closer to the ecological paradigm in which a scientific perspective based on more distance among farming centres and strict fallow period may ensure suitable sanitary and environmental production conditions in the long-term.

In the case of trout and Coho salmon producers, their dissatisfaction was based on the view that their interests were not represented in the adopted solutions, and that those solutions were detrimental to developing the production of trout and Coho salmon (the adopted measures were meant to solve problems of Atlantic salmon production). There was discontent about the priority given to the protection of the production of Atlantic salmon over other species such as trout and Coho salmon, which are also part of the salmon industry. As a result a new association (and a new industry policy subsystem) was created. This new association was called Acotruch and formed by five firms[53] that together represented about 10%of the national salmon production in 2008 (Aqua.cl, 2009d).

The Association began in February 2009, a month later the project law to modify the GLFA was submitted to the Congress for legislative work, but it was legally formalised in July 2009 with the aim of representing small and medium firms and in this way present to the authorities and the industry their reality (Acotruch, 2013).

According to the President of Acotruch, between the firms that left SalmonChile and formed Acotruch and SalmonChile there was agreement in the modification of the GLFA but not in the measures to be adopted nor in the sanitary programmes. Although everybody agreed with the concept of fallowing, the conflict was over the period of fallowing. Salmon species have different production cycles and this was not taken into account by the authority. The President of Acotruch explained to Aqua that the farming of Coho salmon requires 11 months for the grow-out phase and 1 month of fallowing, whilst the farming of Atlantic salmon is 21 months and the farm should fallow for 3 months. If the fallow period for Atlantic salmon (three months) is applied to Coho salmon, Coho salmon producers would be losing revenues for about two years, which would increase the production costs and lead some firms to bankruptcy. In this way, the placement of smolts into the sea, the periods of grow-out, harvest and fallow of farming centres should be set considering the physiology of the different salmon species, and not just favouring the Atlantic salmon (Aqua.cl, 2009d). It is understood that the most damaging scenario for Coho salmon producers would be to fix the fallow periods of Atlantic salmon (three months) after every production cycle because this implies that Coho salmon producers would need 28 months to produce two cycles of salmon that prior to the measure took 22 months (each cycle is 11 months)[54].

Finally, another proposed measure with high conflict and ambiguity was the discussion on the *import of salmon eggs*. Some actors, such as salmon egg producers, argued that the import of eggs implied the import of diseases and therefore the import of eggs should be disallowed. Others, opposing this view, argued that the problem was the control of diseases of imported eggs rather than the import itself. Also, it was unclear if disallowing the import of eggs could be seen as a trade restriction. As a representative from a producer firm said, 'Chile is defined

[53] Salmones Aysén S.A.; Salmones Caleta Bay S.A.; Salmones Ice Val Ltda.; Comercial Mirasol S.A. and Salmo Pacific (Aqua.cl, 2009d).

[54] Eleven months on growing + 3 months fallowing + 11 months on growing + 3 months fallowing = 28 months in two production cycles.

as a highly open country to the foreign trade with free trade agreements, and to put restrictions on trade goes against the DNA of all economic policymakers...any restriction on trade is an invasion to the [economic] system'. The government defended the position of Chile as open-trade country.

The following table summarises the conflict and ambiguity over some issues of the design of policy responses.

Table 7.1: Conflict and ambiguity from the design of policy responses

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Conflict:
- Incompatibility of policy goals, interests, values, activities
- Disagreement over means
- Restriction of the behaviour of the addressees</td></tr>
<tr><td>Low</td><td>High</td></tr>
<tr><td rowspan="2">Ambiguity:
- Misunderstanding and/or uncertainties in policy goals, instruments, instrument settings
- Different interpretations of policy goals, scope and/or instruments
- Misunderstanding and/or uncertainties in the role of actors
- Uncertainty in capability and/or capacity and resources to reach policy goals and/or implement policy instruments
- Ambiguity in policy language</td><td>Low</td><td></td><td>- Favouritism to Atlantic salmon
- Favouritism to larger firms
- Concession scheme</td></tr>
<tr><td>High</td><td>- Scientific base of the HMAs
- Environmental and sanitary effectiveness of the HMS
- Some practices to be adopted</td><td>- Production in lakes, estuaries and rivers
- Relocation of concessions
- Import of salmon eggs</td></tr>
</table>

Source: Own elaboration based on analysis and using Matland (1995) and Slembeck (1997) as theoretical base

7.2.2. Conflict and ambiguity to reduce the policy responses into practice

Policy responses in the stabilisation stage were developed and delivered without delay due to the urgency in controlling the virus. Since the responses were urgent, new and potentially radical, during the early stage of their implementation there were difficulties in bringing them into practice and implementing them in the way that was intended. As noted by Slembeck (1997, 2003) and Howlett, Ramesh and Perl (2009) a reason that explains the difficulties in putting the policy into practice was due to the principal agent problems among actors. Kingdon (2003) pointed out that this may also occur due to the technical and political infeasibility over policies. In the Chilean salmon industry principal agent problems[55] between the legislative (the state) and bureaucrats (Subpesca and Sernapesca), and between the bureaucrats and addressees (producers and suppliers) were observed. Moreover, some responses were technically and politically infeasible. In the same way, Matland (1995) and Slembeck (1997) point out that conflict and ambiguity play a key role in implementing policies.

In the Chilean industry, both the principal agent problems, and the infeasibility of some responses, revealed that the conflict among actors due to their incompatibility of policy goals, activities, interests and values, and the restriction of the behaviour of the addressees as well as the ambiguity of policies and measures, played a key role in putting the policy responses to the crisis into practice. This is analysed below.

Some difficulties in translating the policy responses into practice are the consequences of conflict and ambiguity during their design. For example, for points in which actors did not reach agreement, the conflict was passed to the implementation stage. Other difficulties in the first stage of implementing the policies were inherent due to their novelty, the increasing influence of the ecological paradigm over policy issues, and the discontent with the short-term measures from some actors. Since the industry experienced fundamental changes, it had to operate in a different way compared to prior to the crisis. For this, a new system had to be developed that required new understandings, priorities, beliefs and agreements. The establishment of this new system created a contested process involving new discussions and efforts to negotiate the implementation of and adjustments to the policy responses.

The first part of the table below shows some issues that were not solved during the design of the policy responses and whose conflict and ambiguity passed to the implementation stage, and its corresponding difficulty in the early stage of policy implementation. The second part shows the inherent difficulties of the first stage implementing the policies.

[55] The state depends on the bureaucrats who at the same time depend on the addressees to effectively implement policy.

Table 7.2: Difficulties in reducing the policy responses into practice

Conflict and ambiguity during the design of the policy responses	Difficulty in putting the new regulatory framework into practice
Scientific base (HMA model)	Environmental coalition does not share the goals of the law and contested the implementation of policy responses
Environmental and sanitary effectiveness (HMA model)	
Favouritism to Atlantic salmon (HMA model)	Fallow period fixed at three months for all species is detrimental for the production of Coho salmon and rainbow trout
Production in lakes, estuaries and rivers (HMA model)	Avoiding smoltification in lakes, rivers and estuaries is detrimental for the production of Coho salmon and rainbow trout
Inherent difficulties of the early stage in implementing the radical measures	
Implementation of ISA and Caligus Programmes Self-governance of HMA Logistics of the HMA model such as transport and ports Fallowing of collection centres as part of the HMA model Fallowing of centres with different species as part of the HMA model	

Source: Own elaboration.

Low conflict and low ambiguity:

When both conflict and ambiguity are low in the implementation of policy responses, policy goals are clear, understood and shared by the actors as well as the means to achieve those goals, although there are some uncertainties in the resources to implement some responses (Matland, 1995).

In the early stage of the implementation of the new policies, the overarching goal of the policy was clear: to control the virus and to improve the sanitary and environmental conditions of the industry in order for it to recover from the crisis and ensure a continuous growth in production. This goal was understood and shared by the legislature, the bureaucrats (i.e. Subpesca and Sernapesca) and those addressed (i.e. producers and suppliers).

The role of the bureaucrats was clear: Sernapesca specified the ISA and Caligus Programmes. Bureaucrats and addressees cooperated to reach the objectives of the policy and the implementation process was a purely bureaucratic procedure (a term used by Slembeck, 1997). During the *implementation of the ISA and Caligus Programmes* there were no principal-agent problems, and it was technically and politically feasible to implement the policy instruments, although there were some uncertainties in the implementation of some measures as they were intended due to the increased costs for the firms to implement them.

In their new roles, the bureaucrats (especially Sernapesca) began many new activities, some of which were fairly demanding. It was shared across interviewees that they did not have sufficient resources, and there was no agreement across interviewed actors whether Sernapesca had the capabilities to implement the new policies. The ecological coalition did not participate in the implementation of these measures, whilst the neoliberal coalition cooperated in implementing the policy instruments.

Low conflict and high ambiguity:

When the intensity of the conflict is low and the intensity of the ambiguity is high the outcomes of the implementation of policy responses are hard to predict and they largely depend on the actors and their resources (Matland, 2005).

In the early stage of the implementation of the HMA model there was uncertainty in how the *self-governance of the HMAs* would be, for example, according to Aqua one issue was the way of reaching agreements in the logistic operation (e.g. movement of personnel and ships in the areas), and how consensus would be achieved (e.g. definition of the period of the year in which the zone is fallowing). The self-governance of the HMAs was highly influenced by the ecological paradigm since production and commercial decisions per area were now affected by, for example, the physiology of species in the areas and disinfection procedures in the farming centres of the area. Aqua reported that some industry participants disagreed with a majority system in decision making, preferring a consensus system or a unanimous vote. Whatever rules were adopted, there was a need to develop a set of rules for the operation of this new model (Aqua.cl, 2010a).

With the implementation of the HMAs the logistics of the industry became more complex than prior to the crisis for several reasons: for example, restrictions were made on the movement of fish and the use of ports. The establishment of 'dirty' and 'clean' ports was proposed. Dirty ports would receive materials from the farming centres whilst clean ports would send materials to the farms. According to interviewees, this proposal was technically unfeasible and could not be implemented given the size and the infrastructure of the ports. The influence of the ecological paradigm on this issue was also clear because disinfection and cleaning procedures of ports, as well as the movement of potentially contaminated fish, were important requirements for the success of the new production model. The *logistics of the HMA model* also affected the structure of the industry because new arrangements and agreements among actors on the use of common facilities and tracking of fish and material for production were needed to continue and improve the production of the industry.

Since, with this category of consequences, i.e. the conflict was low, principal-agent problems were not expected. Principals (e.g. producers and bureaucrats) and agents (e.g. suppliers and producers) cooperated to put the policy responses into practice and sometimes reduce the ambiguity of them. The ecological coalition did not participate in implementing these measures, and the neoliberal coalition cooperated in implementing the policy responses while informing the authority concerning the technical infeasibility of policy instruments.

Low ambiguity and high conflict:

When the intensity of the ambiguity is low and the intensity of the conflict is high, although policy goals are clear and understood by the actors they do not share them. This results in the implementation of policy responses being decided by power and the implementation process is open to influence from the actors (Matland, 1995).

In the early stage of the implementation of the new policies there was conflict between the environmental coalition and the neoliberal coalition. *The environmental coalition did not share the goals of the law and contested the implementation of policy responses*. NGOs claimed that the policy responses did not solve the fundamental problems produced by the salmon industry, which were of an ecological nature. Reported by Aqua, they argued that the responses did not include substantial measures to guard the ecosystems in which the salmon industry is based (Aqua.cl, 2009f). The ecological coalition continued with its information strategy and denunciations, mainly via media campaigns, trying to influence the implementation of the policy responses. Information was delivered in the form of blogs, opinion columns and publications. This was public information that could be accessed from the websites of NGOs such as Fundación Terram (www.terram.cl), Ecoceanos (www.ecoceanos.cl) and Oceana (www.oceana.org).

During the implementation of policy responses, the conflict between Acotruch (the new industry subsystem and part of the neoliberal coalition) and the government about the non-differentiation of fallow periods between Atlantic salmon and the other species, Coho salmon and rainbow trout, was intensified. As they argued and expressed during the design of the HMA model, but they were ignored, they believed that the *fallow period fixed at three months for all species was detrimental for the production of Coho salmon and rainbow trout*, and favoured the production of Atlantic salmon and that this specie was prioritised and protected over Coho salmon and trout (La Segunda, 2010). With this fallowing measure the production of

Coho salmon and trout was seriously affected since the production cycle for these species is different from Atlantic salmon and it would result in fewer fish being produced over the years.

According to fieldwork, Acotruch started to negotiate this measure directly with the government, providing feedback on it. Since Coho salmon and trout producers were ignored on this topic during the policy reform process, the state was unable to anticipate detrimental consequences for the production of Coho salmon and trout. Although all the involved actors were listened to in the deliberation process, only some feedback was taken into account.

Acotruch, which is part of the neoliberal coalition, strongly resisted the proposed equal treatment of all the species, ignoring the fact that the species cultivated in Chile have different production cycles. Specifically, Acotruch disagreed with the settings of the HMA model and proposed that the practices of placement of smolts in the sea, grow out periods, harvest periods and fallow periods should consider the physiology of the distinct species and not favour just one specie –the Atlantic salmon (Aqua.cl, 2009d).

High conflict and high ambiguity:

When both conflict and ambiguity are high the goals of the policy are abstract or referential, and there are coalitions competing for interpreting and implementing the policy responses according to their interests (Matland, 1995).

According to interviewees, at the beginning of the implementation of the HMA model there was high ambiguity regarding how the *fallowing of farms producing different species* would be carried out. Different species have distinct production cycles and it is not technically feasible to achieve the same marketable fish as before for all the species when they are forced to adapt their production cycle, or the production of some species would be reduced over time. At the beginning, the regulation indicated that the entire HMA should fallow at a certain date. Also there was no consideration about how consensus on this topic would be achieved (e.g. would the authority provide the actual information or would there be a quorum among the firms to agree the timing of the production period). This unclear information generated difficulties in the business planning of the firms (Subpesca, 2010).

An interviewed lawyer explained during fieldwork that another unclear point of the responses was the situation faced by the collection centres. He said that, at the beginning, it was not clear whether the collection centres actually had fallow periods or not, and if they had fallow periods when they occurred. Collection centres are centres inside the HMAs that are meant to collect and keep live fish waiting to be processed. When an HMA in which these centres are located is in fallowing, the centres cannot be in fallowing without ceasing their function. Collection centres receive live fish from multiple HMAs and if they are in fallowing this means there will not be a place to keep live fish before they are processed, which reduces capacity and generates problems in the production chain. Thus, the *fallowing of collection centres* is technically infeasible.

Both the fallowing of collection centres and the fallowing of farms with different species affect the structure of the industry. When the collection centres cease their functions this reduces the capacity of the system and the live fish to be kept should be send to other collection centres or directly to the process plants. New logistics should be developed for that. On the other hand, the fallowing of farming centres with different species could imply a reduction of production of some species over time or smaller fish, which implies a reduction in their exports or revenues from their sales.

As a policy response, the *avoiding of smoltification in lakes, rivers and estuaries* was also discussed. This practice was evaluated as a high risk practice for ISAv. During the implementation of policy responses, the conflict on this measure was also intensified. This was because it affected the costs and structure of salmon production as part of the production would be moved to facilities other than lakes, rivers and estuaries. According to Acotruch's representatives, smoltification in lakes, rivers and estuaries has been an important comparative advantage for the Chilean industry. The most affected producers would be the Coho salmon and trout producers, which are for the most part smaller firms. Since ISAv does not affect Coho salmon and trout, Acotruch strongly disagreed with the proposed cessation of smolt production in rivers, lakes and estuaries and continued contesting this measure.

The ecological coalition did not participate in the implementation of these policy responses, and the neoliberal coalition interpreted the unclear points of the policy in their favour, for example, explaining to the authority the technical infeasibility of the fallowing of collection centres, and the problems in considering the same fallowing period for centres producing different species.

Despite the development of policy responses to stop the epizootic and control the virus, a short-term consequence was that in 2008 the virus had already spread to Aysén (Region XI), and in November 2010 the first outbreak of ISA was found by Sernapesca in Magallanes, Region XII (Sernapesca, 2010a). With this, the virus was already present in all of the three regions where the salmon production takes place and therefore endemic to the entire Chilean industry.

The participation of the banking sector during the early period of implementation was crucial to push the industry to comply with the sanitary requirements of the new regulatory framework. As was pointed out in Chapter 5, the sanitary crisis helped the banking sector to recognise the high risk of the industry. Reported by Aqua, at the beginning of 2013 industry debts reached US$1,700 million, and the banking sector was closely monitoring the regulation of the industry and the sanitary behaviour of firms. Banks were interested in knowing about the sanitary situation of firms and the industry, and they requested meetings with the Undersecretary for Fisheries to discuss the regulatory changes for the aquaculture business.

In one of those meetings the banking sector pointed out the need for more accurate, transparent and timely information for the industry in order to evaluate the firms' risks better (e.g. number of fish into the water, mortality levels, the presence of caligus per HMA, harvest weight). The Undersecretary facilitated this process by offering meetings between the technical team of Subpesca and the banks, and by expressing interest in collaborating with the banking sector to help the firms solve their financial difficulties (La Tercera.com, 2013; Aqua.cl, 2013d).

The following table summarises the conflict and ambiguity in putting the policy responses into practice.

Table 7.3: Conflict and ambiguity to reduce the policy responses into practice

		Conflict: - **Incompatibility of policy goals, interests, values, activities** - **Disagreement over means** - **Restriction of the behaviour of the addressees**	
		Low	**High**
Ambiguity: - **Misunderstanding and/or uncertainties in policy goals, instruments, instrument settings** - **Different interpretations of policy goals, scope and/or instruments** - **Misunderstanding and/or uncertainties in the role of actors** - **Uncertainty in capability and/or capacity and resources to reach policy goals and/or implement policy instruments** - **Ambiguity in policy language**	**Low**	- Implementation of ISA and Caligus Programmes	- Environmental coalition did not share the goals of the law and contested the implementation of policy responses - Fallow period fixed at three months for all species is detrimental for the production of Coho salmon and rainbow trout - Avoiding smoltification in lakes, rivers and estuaries is detrimental for the production of Coho salmon and rainbow trout
	High	- Self-governance of HMA - Logistics of the HMA model such as transport and ports	- Fallowing of collection centres as part of the HMA model - Fallowing of centres with different species as part of the HMA model - Avoiding smoltification in lakes, rivers and estuaries was detrimental for the production of Coho salmon and rainbow trout

Source: Own elaboration based on empirical analysis and Matland (1995) and Slembeck (1997) as theoretical base.

7.3. Long-term consequences of policy response to the sanitary crisis

The long-term consequences of the policy responses are those related to the long-term policy responses that occurred during the improvement, adjustment and restoration stages of the crisis (i.e. recovery phase). The policy responses were incrementally adjusted, mainly during the recovery phase of the sanitary crisis, towards reducing their conflict and ambiguity. For some responses it was possible to reduce the conflict, but not the ambiguity, whilst for others, it was possible to reduce the ambiguity, but not the conflict. In some cases both the conflict and the ambiguity were reduced. However, there were some measures in which it was not possible to reduce either the conflict or the ambiguity. The adjustment of policy responses also produced new consequences, which are shown in Table 7.4.

From the conflict and ambiguity perspective, what is involved is addressing the issues with high conflict and high ambiguity through changes and adjustments of the policy instruments and their settings. The adjustments of policy instruments and instrument settings through the evolution of conflict and ambiguity is understood as the movement of the policy issues from one quadrant to another in the conflict-ambiguity matrix, as explained below.

In the process of reducing the conflict and ambiguity of policy instruments, the policy system involved was 1) the government ,i.e. Sernapesca and Subpesca, 2) the industry as represented through their associations, SalmonChile and Acotruch, and 3) the providers represented by their associations, including Arasemar, Armasur and Atared to name but a few.

Low conflict and low ambiguity:

According to fieldwork and secondary data, for five policy responses or policy issues it was possible to reduce their conflict and ambiguity through adjustments. These are:

- self-governance of HMAs;
- logistics of the new production model, such as transport and ports;
- fallowing of collection centres;
- fixed fallow periods for all species; and
- avoiding smoltification in lakes, rivers and estuaries.

In the conflict and ambiguity matrix they now appear in the low conflict and low ambiguity quadrant.

To reduce the ambiguity of the *self-governance of HMAs*, the authority gave some latitude for action (a term used by Slembeck, 1997) to the firms operating within the HMA model to organise themselves and facilitate the self-governance of the areas. Subpesca (2011) reported that the government enabled this latitude for action by announcing that concession holders may adopt measures additional to those set by regulations in terms of management plans for productive, logistic or sanitary measures, with the aim of improving the sanitary and/or environmental behaviour of the group of concessions in the area. These actions, as well as the responses to directives, should be incorporated in a management plan presented to Sernapesca for approval and monitoring. The issues that were agreed were: the cultivation of just one specie, fallowing of border concessions within less than three nautical miles at pre-determined times, ports to be used, and navigation tracks segregated by risk, modification of the cultivation location according to oceanographic conditions, monitoring programme for algal bloom, contingency plans and fallowing programmes for all or just one part of the group of concessions.

According to Subpesca (2011) the adoption of agreements in the HMA required absolute majority of the concessions belonging to the group of concessions. In this majority, at least 80% of the concessions should be holders declaring an intention to operate in the next productive cycle. The quorum for agreements should be unanimous in the case of the cultivation of just one species, the fallowing of border concessions and fallowing programme for all or just one part of the group of concessions. The quorum for agreements always refers to the total of existing concessions in the group of concessions and not to the concession holders.

Regarding the *logistics of the new production model such as transport and ports* the ambiguity was reduced enacting more regulations. In November 2011 the regulation for embarking and disembarking points (ports) of farmed salmon species was issued by Resolution N°2323 (Chilean National Congress Library, 2011q). The regulation set the health management conditions for the points intended for loading and unloading of hydrobiological resources (live or dead), products, food and nets used in the salmon activities. The points may be exclusively for loading, or exclusively for unloading, but there is also the possibility they may be for both loading and unloading. The regulation specified that the points of loading and/or unloading must have their own equipment and materials for the cleaning and disinfection of facilities, structures, materials and equipment. The person or entity providing the cleaning service and disinfection procedure must be included in the list of service providers to which the Sanitary Regulation refers. Also, it was pointed out that the procedures for cleaning and disinfection should meet the General Sanitary Cleaning Programme.

Based on this regulation, on 17 July 2013 the list of biosafe ports for the three regions where salmon production takes place (Los Lagos, Aysén and Magallanes) was published. Reported by Aqua, the three regions have embarking and disembarking points. In Los Lagos there are 17 points available, whilst in Aysén there are 5 and in Magallanes 6 (Aqua.cl, 2013n).

In 2010 the conflict and ambiguity of the *fallowing of collection centres* was reduced by modifying the sanitary management measures by area. One of these modifications was aimed at incorporating a fallow period of collection centres. This was made by Resolution N°1897 (Chilean National Congress Library, 2010g). The 2010 modification stated that collection centres should fallow in the last month of the three month fallowing period of the area to which the collection centre belongs. This amendment reduced the ambiguity in the policy regarding whether the collection centres have periods of fallowing and when they should fallow.

In 2012 the media reported another modification in the measures for collection centres. In this case the modification was aimed at eliminating the condition enforced by the regulation regarding the assurance of 'no water exchange on arrival'. Since it is not possible to comply with this condition, the modification made possible what is actually feasible. Also the adjustment of the operation time of collection centres whose concessions have expired or will expire soon was proposed (Aqua.cl, 2012g).

In relation to the *fixed fallow periods for all species*, after the new law was passed (Law N°20434) and given its discontent, Acotruch started to negotiate directly with and lobby the authorities in order to make its feedback known on the HMA model, especially on the three months fixed fallow period, which corresponds to the setting of this instrument. Aqua reported that Acotruch informed the authority several times of the need to reduce the coordinated fallow period from three to two months for Coho salmon production centres. Acotruch also specified that the fallow regulations created problems with infrastructure and services (e.g. trucks, process plants and refrigerators) during periods when harvests are concentrated. This made the situation even more complex for small and medium producers of this species that have fewer aquaculture concessions (Aqua.cl, 2013f; Aqua.cl, 2013b).

In May 2013, Acotruch again met the Ministry of Economy and the Undersecretary of Fisheries to reiterate their requests regarding to the fallowing period for Coho salmon and the threat to small and medium firms. In that meeting, the Undersecretary of Fisheries expressed the intention of including in the next amendment of the Sanitary Regulation (RESA) the request that reduced the fallowing period of Coho salmon for farms which place into the sea up to 600,000 fish from three to two months (Aqua.cl, 2013b). Thus, in July 2013 the Undersecretariat of Fisheries (Subpesca) drafted legislation for Coho salmon in order to reduce the fallowing period of farms producing Coho salmon from three to two months. According to the Undersecretary of Fisheries, since smaller and medium firms have complicated continuous production cycles due to having fewer concessions, this initiative would generate a positive effect from the point of view of giving continuity to these firms. The reduction of the fallowing period for Coho salmon did not have sanitary effects for ISA since this specie does not develop the disease (Aqua.cl, 2013l); however, this specie could be a vector for the disease as pointed out earlier.

Given lobbying and pressures from Acotruch, measures about fallowing in farming centres have taken a different course than that proposed earlier. The authority considered the proposal of one month fallowing for Coho salmon farms once this specie had completed 11 months of productive cycle. In practice this means having two separate fallowing periods in two years for the production of Coho salmon. The adjustment of the settings of the HMA model due to the influence of Acotruch demonstrates the power of a minority group of the industry over sectoral regulation.

Coho salmon and trout producers are mainly smaller and medium firms producing species (Coho salmon and rainbow trout) that are not the most profitable specie for the industry, unlike Atlantic salmon; it also has a lower production than Atlantic salmon. This also demonstrates that the formation of Acotruch was, from these producers' viewpoint, a success. What was lost in dividing the industry voice by creating this new Acotruch subsystem was compensated by succeeding in influencing industry policy.

To reduce the conflict and ambiguity regarding *the smoltification in lakes, rivers and estuaries*, the media report that the Expert Panel formed by the government recommended that the smoltification of Coho salmon, rainbow trout and Chinook salmon was allowed, with a specific sanitary programme, in zones that Sernapesca has declared free of diseases from List 2. Smoltifications were also allowed for a period of three years in zones declared as surveillance zones by Sernapesca for List 2 diseases with a control programme. After these three years the measure would be re-evaluated based on the relevant updated sanitary and environmental information. According to Subpesca, since there is no conclusive evidence that Coho salmon, rainbow trout and Chinook salmon are vectors of ISA, the smoltification in surveillance zones should carry a low risk of ISA (Subpesca and Fundación Chile, 2011).

In a meeting held in October 2011, Acotruch expressed its concerns to Sernapesca regarding this measure saying that, after the three years, it created uncertainty with effects on investments (Aqua.cl, 2011g). In its recommendations the Expert Panel recognised the comparative advantages of the Chilean waters in developing aquaculture, and it estimated that it was not adequate to disallow the future possibility to use all available water bodies, in particular the estuaries (Subpesca and Fundación Chile, 2011). On the other hand, the Expert Panel recommended the restriction of the smoltification of Atlantic salmon in zones declared free of diseases listed in List 2 by Sernapesca, with a specific sanitary programme. The smoltification of Atlantic salmon should be carried out just in hatcheries, but the possibility of producing smolts in rivers, lakes and estuaries in zones declared as free zones of diseases listed in List 2 in the future was preserved.

Rivers, lakes and estuaries present a much higher probability of contagion than hatcheries. At the time of the Expert Panel report it was pointed out that the majority of smolt producers of Atlantic salmon were migrating to freshwater, especially hatcheries. This measure sought to reduce ISA in Atlantic salmon by curtailing production of this specie in lakes, rivers and estuaries. It is claimed that this measure did not have a great economic impact (Subpesca and Fundación Chile, 2011).

The development and delivery of new policies and their adjustments brought a new language to the policy makers, authorities and the industry that sometimes resulted in *norms with complex language*. Also *smaller firms had lack of resources* to comply with the new policies. On the issue of norms with complex language, a report of a workshop about the implementation of the new law (Law N°20434) reported that there were a large number of norms with technical language, and that the norms were difficult to understand and interpret. For instance, there was no definition of important concepts such as 'healthy fish' and some terms such as 'slaughter' should be specified (Subpesca, 2010). New words such as biosecurity, surveillance zones, group of concessions, closed, semi-closed and open wellboat, biosafe port, embarking, disembarking and mixed point, sanitary certificate, to name a few, emerged as part of the industry policy learning and policy change.

In order to reduce the ambiguity of the language and gain a common understanding of the new policy instruments including the policy goals, the bureaucrats (from Subpesca and Sernapesca) started an information diffusion campaign to create reference information and to disseminate this information via workshops, meetings and their websites (www.subpesca.cl; www.sernapesca.cl). Industry actors through their associations (e.g. SalmonChile, Acotruch, Arasemar, Armasur) also had their own information campaigns via regular meetings, workshops and information through their websites.

On the issue of lack of resources for smaller firms, although the goals of the regulations and programmes were understood and shared by the regulated firms, it was said that the new sanitary and environmental requirements would increase production costs by approximately 30%. Since the industry is heterogeneous in size and conditions (e.g. infrastructure and geographic distribution of farms) the increase in costs is not the same for all the firms and it was estimated to vary between 20% and 30% or more. Smaller firms might not have sufficient resources to comply with the new requirements (Aqua.cl, 2011c).

Reported by Fish Information and Services, in 2010 when the new law (Law N°20434) was approved, the banking sector calculated that the industry would have to invest more than US$ 1,000 million between 2011 and 2014 to meet the new sanitary and environmental requirements. From these US$ 1,000 million, about US$ 400 million should be for the development of new infrastructure to increase and improve the biosecurity levels and the controls to avoid contamination (Fis.com, 2010). Aqua points out that, according to information from the industry, the major costs facing the firms with the regulatory modifications were the fallowing, which implies approximately 30% less production, the smoltification on land, which is 30%-50% more expensive than smoltification in lakes, the restriction on imports of eggs, which increased their costs by 40% (the cost of domestic eggs has been higher than the cost of imported eggs), investments in the management and control of mortality using silage, the application of vaccines, the transport of fish using wellboats with closed recirculation systems, disinfection of water and ultraviolet equipment (Aqua.cl, 2010c; Aqua.cl, 2011c).

As seen in the previous chapter, the modification of the GLFA was in part aimed at reducing the industry's financial risks. According to an interviewee from the banking sector, to achieve this aim there was a change in the funding of the industry. The treatment of concessions as collateral facilitated negotiations between the banking sector and the producers; it allowed the refinancing of debts. However, in the financial structure of the industry, post sanitary crisis, the banking sector had less participation, which implied a reduction in the debt-equity ratio[56] of firms and therefore of the industry. In this new scenario larger firms adopted the strategy of obtaining financial resources from the stock exchange. However, this was not a strategy that could be adopted by smaller firms, said another representative from the banking sector.

As reported by Aqua, in general the money raised from the stock exchange was used to cover operations and pay back part of the debts to the banking sector (a negotiation that took place during the modification of the law). Aqua reported that in the attempt of raising money from

[56] 'A measure of a company's financial leverage calculated by dividing its total liabilities by stockholders' equity. It indicates what proportion of equity and debt the company is using to finance its assets'. (http://www.investopedia.com/terms/d/debtequityratio.asp Last accessed: 17 October 2013).

the stock exchange, the largest Chilean capital firm, AquaChile, was the most successful offering in the stock market with a capitalisation of US$ 373 million. Approximately 40% of the raised money was allocated to paying debts with the banking sector due to the sanitary crisis, and the rest of the money was intended to finance the business plan over the next five years and for future investments (Aqua.cl, 2011d).

In June 2011 the Santiago Stock Exchange created the salmon sectoral index confirming that salmon was an economic sector with high presence in the Chilean stock market. In 2011, there were already eight firms (six national and two multinationals) participating in the stock market (Bolsa de Comercio de Santiago de Chile, 2012; Grupo Editorial Editec, 2013b).

There was complete agreement across the interviewees that the financial effects of the crisis on firms, together with the increase in costs due to the new regulations, would lead to a consolidation of the industry with fewer producer firms and greater vertical integration. The common opinion in the industry was that the process of consolidation would result in the creation of five or six larger competitors. Aqua reports that in the SalmonChile Association alone there were 25 producer firms (Aqua.cl, 2012e). According to interviewees a consequence of the consolidation would be an easier management of sanitary conditions in the industry, since it is easier to reach consensus among fewer firms.

Aqua points out that different actors in the industry agree with the consolidation model as the most efficient form to recover the production levels of the industry and accelerate its recovery, which was not expected to be before 2015 (Aqua.cl, 2009c). Also reported by the media, speculations about mergers and acquisitions started in 2009 during the modification of the law and negotiations between the producers and banking sector. Since in Los Lagos and Aysén Regions, it was not possible to grow via the acquisition of new concessions due to a halt in the creation of concessions, firms started looking to Mergers and Acquisitions as the possibility for growth[57]. According to some analysts interviewed by Aqua, by 2014 the number of producer firms would be reduced by half (Aqua.cl, 2012b). However, there are no signs that this is happening so far.

The perception of the industry from the regional communities was also an issue mentioned by interviewees regarding the consequences of policy responses to the sanitary crisis. Although the industry has brought economic benefits to the southern regions where production takes place, mainly Region X, it was reported by some interviewed NGOs and researchers that there

[57] Some M&A were El Golfo-Itata, Cultivos Yadrán-Andritz, Friosur-Landes and Vestisqueros-Congelados Pacífico (Aqua.cl, 2011f; 2013m; 2013o).

is resistance to the industry from some groups such as environmentalists and pro-labour groups. According to them, the feeling of these groups is that the industry abuses the environment and local communities, and that this abuse comes mainly from large multinational firms that came to Chile to contaminate the environment because they cannot contaminate their own home countries (e.g. Norway). This abuse has also been extended to other sectors that are located in those regions such as artisanal fisheries, tourism, and mussel and algae sectors.

The sanitary crisis deepened the sense that the recipients of the industry's negative externalities and the consequences of the crisis were for these sectors. An interviewed NGO opined that the support from the state to the industry, in response to the sanitary crisis, such as the financial support via the state guarantee fund CORFO, the modification of the GLFA to renegotiate the industry's debs with the banking sector, and the extension of the industry to southern regions of the country via the granting of aquaculture concessions in Magallanes, were perceived as a scandalous rescue of an industry that had given more negative than positive externalities, which privatised the sea, an asset that belongs to all Chileans, and provoked one of the most serious sanitary crisis in the history of Chilean natural resources.

High conflict and low ambiguity:

On the issue of the *relocation of concessions* it was possible to reduce the ambiguity but not the conflict. The ambiguity was reduced by suspending the granting of concessions in Region X and XI; however, this encouraged the extension of the industry to the southern Region of Magallanes and maintained the conflict at a high level. The new law (Law N°20434) established the suspension of the granting concessions in Region X for five years and in Region XI for two years. After five years it would only be possible to get a concession in Region X if it became available from previous concessions that were renounced or had expired. The aim of this point was to stop the delivery of places for the production of salmon since, according to the government, there were no more suitable places for production in Region X.

At the beginning of the implementation of the HMA model, concessions were permitted to be relocated in the same region, and just in Regions X and XI. However, there was then the possibility of relocating concessions in Region XII (Magallanes), due to the suspension of the granting of concessions in Region X and XI, giving preference to those concessions located into the corridors or macro-zones considered as places incompatible for aquaculture use (Aqua.cl, 2012h).

In June 2012 the government announced the establishment of eight macrozones (five in Los Lagos and three in Aysén). Based on oceanographic and logistics information, it was decided that the corridors to separate the macrozones would have a width of at least five nautical miles. In this scheme firms would have to relocate 72 concessions[58] that were in these corridors, although not all of them were active. The firms were not forced to move their concessions because the government did not have the power to expropriate those licenses. However, Subpesca explained that firms relocating concessions until 2015 would have preference in the process. From April 2015 the farming centres located in the corridors will have to follow stricter sanitary requirements, non-fulfilment of which jeopardises continuation of the concession (Aqua.cl, 2012f).

According to the NGO, Ecoceanos, with the relocation of concessions in Magallanes, and the granting of concessions in this region, the state facilitated and favoured the extension of the industry in this region. Ecoceanos saw this negatively and explained that Magallanes is a remote area that was outside of the industry plans. However, since Regions X and XI were already contaminated with the virus and in fallowing, there have been petitions for concessions in Magallanes. By April 2011 there had been 1,600 concession applications for this region. This conflicted with other activities in the region, mainly with tourism. Ecoceanos said that Magallanes is a region that lives mainly from tourism, and the salmon industry was competing for space with the tourism industry (El Mostrador.tv, 2011). However, the media reported that the delivery of new concessions in Magallanes was seen positively. It would increase the economic activity of the region providing employment, while at the same time reducing the sanitary risks of the industry distributing its production over a larger area (El Mercurio.com,2013).

Reported by the media, the development of the industry in Magallanes has been different from Los Lagos and Aysén Regions. When ISA started in 2007 in Los Lagos, Magallanes had a low salmon activity and the authorities focused on the development of a sustainable model that was in harmony with other activities, thus avoiding the mistakes of the model installed in Los Lagos. For this reason the Law N°20434 (outcome of the reformation process) suspended

[58] AquaChile is the firm with the majority of concessions and it must relocate eight farming centres in Aysén. According to SalmonChile the investment needed to relocate a farming centre is US$ 500,000-US$ 800,000 (Aqua.cl, 2012f).

the granting of concessions during the time the zonification of the regional coastline and the redefinition of areas suitable for the aquaculture were being elaborated. As a result of this process, the areas suitable for aquaculture in the region were reduced, eliminating 60% of the sites available to develop the salmon activity, and that were established for the state in 1994: 2% of the maritime area of internal waters was left available (El Mercurio.com,2013; Aqua.cl, 2013e).

According to the president of the Association of Salmon and Trout in Magallanes interviewed by Aqua, the regional process of defining the use of the coastline was a participative process that lasted two years. This process involved workshops, consultation and meetings, and all the public and private entities related to the coastline. Zones for the distinct economic activities were defined in this process, and many zones were excluded for salmon activity (Aqua.cl, 2013g). Apart from the conflicts with NGOs such as Ecoceanos, Oceana and Terram, indicated previously, the salmon industry faced conflicts with the National Forest Corporation (Conaf for its Spanish acronym) and indigenous communities.

Out of the more than 1,000 aquaculture concessions in the south of Chile, 300 are located inside zones considered as National Parks. Conaf and indigenous communities strongly opposed the granting of those concessions for the development of salmon activities (El Mercurio.com, 2013; Aqua.cl, 2013g). After noting this opposition, the General Accounting Office later decided that salmon activities could not be performed inside National Parks (Aqua.cl, 2013a).

According to the Undersecretary of Fisheries and the industry, both interviewed by the media, Magallanes presents an auspicious growth scenario because this region does not have the high concentration of concessions, like Los Lagos. This was a strategy to reduce the operational risks of new disease outbreaks, because if there are outbreaks in one region the firms may use concessions that are not contaminated in another region, which reduced their losses (Aqua.cl, 2012d). Also, the region is free from piscirrickettsiosis (SRS) and caligus, diseases with which the industry is greatly affected (Aqua.cl, 2013e).

In the case of caligus this is due to the low sea temperature in the region, which does not favour the development of this sea louse. On the other hand, due to the low temperature a longer period is needed for the salmon productive cycle compared to other regions (Aqua.cl, 2013g). Until March 2012 there were 18 concessions granted in Magallanes, however, there were another 44 additional requests. Out of those 44 concessions, 12 would be for the production of salmon (Aqua.cl, 2012d). During 2012 Sernapesca received 516 applications, and at June 2013 there were 61 concessions granted. According to Sernapesca, the granting of approximately 100 new aquaculture concessions were expected at the end of 2013 or beginning of 2014 (Aqua.cl, 2013e).

The Undersecretary of Fisheries pointed out that in 2012 the production of salmon in Magallanes was approximately 33,000 tonnes, with approximately 1,200 direct jobs. For 2016 more than 100,000 tonnes of production are expected with 4,000 direct jobs and 1,000 indirect jobs (Aqua.cl, 2012f). Also there are projects for US$250 million to be developed in the next five years.

The relocation of concessions was based on the idea that it is neither possible to increase the number of concessions nor to increase the area given for concessions. The new law allowed the splitting and merging of concessions. Relocated concessions lost the right to be indefinite and were given just for 25 renewable years. Those concessions located in incompatible areas for aquaculture use according to the new production model, and for Coho salmon and trout producers were preferred for relocation. Acotruch reported to Aqua that this favouritism for Coho salmon and trout producers was perceived for them as an ‘apparent favouritism’, since according to Acotruch this measure did not take into account its real demands, which were related to the favouritism of the production of Atlantic salmon.

The relocation of a concession implied investments that small and medium firms, such as Coho salmon and trout producers, could not assume, and relocated concessions lost their indefinite life. If a small or medium firm did not have a considerable number of concessions (the usual case), the relocation of concessions was not useful (Aqua.cl, 2009d). Also concession holders who were relocating their concessions had preference over other concession applicants asking for the same concession. The Law N°20434 points out that the possibility of relocation of concessions opened a competition for spaces (Chilean National Congress Library, 2010d).

In 2012 there were some modifications to the concession scheme. In Aysén these modifications were aimed at denying all requests on aquaculture concessions that were not aimed at relocation, and limited the preference for the cultivation of salmon and rainbow trout to applications presented before 8 April 2011. These modifications were also aimed at improving the sanitary standards and territorial organisation of those aquaculture concessions (Aqua.cl, 2012g; Aqua.cl, 2012h).

Low conflict and high ambiguity:

A consequence of the development of new regulations that had low conflict but high ambiguity was the *lack of resources and capabilities of the sanitary authority, Sernapesca, to control sanitary and environmental activities*. In the early stage of the implementation of the policy responses, the goals of the policy were clear and shared by the actors (legislator, bureaucrats and industry). However, as it was repeatedly mentioned by all the interviewees, Sernapesca, a bureaucracy, does not have sufficient resources to comply with the new requirements of its role. The modification of the law gave more power to the sanitary authority, which meant that the industry would have more control.

Reported by a bureaucrat, during the time of the crisis the resources of Sernapesca were increased, but after the crisis the resources decreased because they needed to be reassigned to other Sernapesca's activities such as fisheries. A bureaucrat from Sernapesca explained that the state was sensitive to the ISA crisis and gave more resources to Sernapesca, but after the worse part of the crisis passed Sernapesca no longer had sufficient resources to, for example, rigorously implement the surveillance programme. With the resources Sernapesca had, it might have implemented less than half of the proposed surveillance programme.

Thus, on the one hand, the latitude for action by Sernapesca was enlarged via the modification of the law (more power), but on the other hand their latitude of action was narrowed. Therefore the implementation of new policies was less effective and they could not be implemented in the same way as they were intended. There was no agreement across interviewed actors whether Sernapesca had the capabilities (i.e. qualified staff) to perform its role as a controller. The participation of large amount of veterinarians in the organisation was mention; however, it is questionable whether they had the knowledge to deal with fish diseases when they were veterinaries of mammals, for example cows.

High conflict and high ambiguity:

During the long term policy response, *the modification of GLFA* was a controversial process with high conflict and high ambiguity. The Law project was submitted for legislative process at the beginning of January 2009, and it was thought that the new law would be approved in a couple of months. However, the difficulties in reaching consensus and processes of negotiation delayed the approval of the new law until April 2010. In general, actors agreed that a change in the GLFA was needed in order to solve the sanitary crisis itself, its effects, and to update the industry's regulatory framework, including a more preventive approach. However, there were strong criticisms of the government's position and the way in which the modification process was conducted. The conflicts were focussed on the policy instruments – especially the proposed new production model for the industry and the negotiation process between salmon producers and the banking sector.

The government was strongly criticised by environmental NGOs and some legislators for taking a neoliberal position and using economic criteria to solve a situation that was understood by these actors as an ecological problem. The changes in the concession scheme (e.g. concessions as collateral and relocation of concessions) proposed in the law project led to the belief that the government was functioning as promoter as well as regulator, with clear favouritism towards the industry. Even more, some interviewed actors strongly believed that the actual goal in modifying the GLFA was to facilitate the procedure to give concessions as collateral, and in this way give guarantees to the banking sector, ensuring future loans for the industry and solving the financial problems of the producers, rather than being determined by environmental and sanitary considerations. This belief was based on the argument that the main reason to modify the law was to allow concessions as mortgages.

The Salmon Roundtable was strongly criticised by NGOs in devising the modification law to focus only on the salmon industry, despite the existence of different actors sharing the common natural resource water. It was also criticised by the NGOs for ignoring the salmon workers in the discussions from the beginning, since they were deeply affected by the sanitary crisis. A representative from an NGO said that the excuse given for this from the Roundtable was that their aim was to preserve objectivity by not involving workers or businessman in the discussions. However, according to the interviewed NGO, the Roundtable was working with SalmonChile and there was a continuous lobby from the Association to the Roundtable.

Another interviewed NGO opined that the formation of the Salmon Roundtable could have been useful in organising the territory in Region X in a better way by considering the participation of all the actors that share this territory and the common-pool resource water. Later on, Felipe Sandoval (Executive Secretary of the Salmon Roundtable) received personal criticism for taking a job with AquaChile after the modification of the law. This was another argument for believing that the Salmon Roundtable was in favour of the interests of larger producers.

As was seen in Section 3.4.3 (Chapter 3), the sanitary crisis had negative financial effects for the industry, which led to the default of the industry with the banking sector. According to news, in April 2009 industry debts were US$ 4,000 million approximately, representing about 30.4% of the patrimony of the banking sector at that moment, which was US$ 13,170 million (Estrategia.cl, 2009). The negotiations between the banking sector (ABIF) and the salmon producers were based on the job and report(s) of Claro y Asociados (a consultancy firm hired by ABIF). The points of contention between the producers and the banks were in the petitions made by the both sectors: after six months of negotiations there was agreement between the two groups. Bórquez (2009) reported the requests of producers and banks. On the one hand the producers requested for more comprehension and flexibility from the banks, arguing the importance of the industry for the country and the economy of the southern regions. Given the high mortality of fish and decrease in production, producers pointed out the difficulties in paying back the money to the banks, a situation that could be aggravated if there is inflexibility from the banks in considering their requests. There were three main requests from the producers:

- Exemption from industry debts: producers appealed the same consideration that the banking sector had during the military government in 1982[59] when the industry was considered a key sector of the economy.
- The flexibility for the sector in delaying payments: producers requested for a reasonable time to give the money back to the banks, as well as grace years according to the characteristics of the sector.
- Concessions as collaterals: the possibility of giving the aquaculture concessions as mortgages. This point was already considered in the modification of the GLFA.

On the other hand, since it was demonstrated that the salmon itself (i.e. biomass) was not a real collateral, the banks requested real collateral and assurance from the industry to prove that it was able to pay back its debts and credits. There were also three requests from the banking sector:

- Give shares as securities: at the beginning of the negotiations this point was the most inflexible one from the producers, however, in the end the industry agreed.

[59] In 1982 the major economic crisis was suffered in Chile.

- Banking sector as inspector: the request to have a presence in the firms in order to guarantee the adequate use of the credits. Producers had no major objections.
- Renegotiation conditions: the banking sector agreed a time between seven and ten years to the payment of debts, and grace periods of between two and five years.

Although the debts of the industry to the banking sector involved important sums of money, Bórquez (2009) explained that the government did not participate in the negotiations between the producers and the banking sector. However, it provided support actions such as the development of a new regulatory framework, including the modification of the GLFA and the updates of RESA and RAMA, the state guarantee fund CORFO, and the defence of country image. These actions were aimed at activating the industry, which is considered as a key sector for the country.

In terms of the coalitions both the neoliberal and the ecological coalitions requested improvements in the industry's regulatory framework. The ecological coalition contested the modifications to the GLFA proposed by the Salmon Roundtable, and proposed issues that should be taken into account in the modification of the law. These issues included an updated concession scheme with the redefinition of suitable areas for the aquaculture and the location of the concessions according to this redefinition. Also included was the granting of concessions in natural places of hydrobiological resources, the end of aquaculture in rivers and lakes, an environmental damage insurance, the setting of maximum limits of harvest, the use of antibiotics and the extension of the industry to Magallanes (FundaciónTerram, 2009). The issues were proposed by different agents of the coalition such as Fundación Terram, Ecoceanos and Oceana. The efforts of the coalition were focussed on revealing the limitations and perils of the policy responses and the neoliberal approach. However, there were no counter proposals for the HMA model, and the HMA became the only new model for the organisation of the industry.

The ecological coalition was fragmented in defending the issues of the ecological paradigm. That is, some actors of the coalition proposed specific issues to be included in the modification of the law but they were not united in a specific campaign. For example, Fundación Terram mainly defended a more holistic approach of the aquaculture policies and the use and management of the coastline; Ecoceanos mainly defended the extension of the industry to Magallanes; Oceana mainly defended issues related to salmon escapes and the use of antibiotics. Ecological and marine biologist researchers defended the development of diseases in fish and aquaculture environment and animal welfare.

In the neoliberal coalition, although there was an important fragmentation reflected by the organisational fission of the Association of Salmon Industry (SalmonChile). With the departure of the Coho salmon and trout producers and the subsequent formation of their own Association Acotruch and the departure of AquaChile, the fragmented neoliberal coalition could still defend the core of the neoliberal policy paradigm (i.e. ensuring a continuous growing production of salmon). This was because the fragmentation of the neoliberal coalition was not a result of disagreements about the core of the policy they were defending, but, using Sabatier’s (1988) wording, as a result of discontent in the secondary aspects of the policy, which suggested that the policy paradigm remained unchanged.

While the neoliberal coalition’s main goal was to regain the production levels prevailing prior to the crisis as soon as possible, the ecological coalition requested better sanitary and environmental conditions. For the neoliberal coalition the sanitary and environmental conditions of the industry were means to achieve a continuous growing production; however, for the environmental coalition they were ends in themselves.

During the modification of the industry regulatory framework, an issue that was left with a high level of ambiguity was the *revocation of the concessions* due to three breaches of agreements in labour issues from the firm in a period of 18 months. According to an interviewed Trade Union, this measure was too difficult to implement because, first, there was to be a two year period of an experimental run of the new regulatory framework in which this issue would not be implemented, and second, the revocation of concessions related to the unfulfilment of the labour-law was not a serious proposal. This was because employees should tolerate at least three unfulfilments with the labour-law by the firm in 18 months and just then the concession is revoked.

During the recovery stage the neoliberal coalition, mainly Acotruch, was more effective than the ecological coalition in influencing the adjustments of policy instruments. The settings of the HMA model were adjusted as the result of the lobbying and pressure by Acotruch. On the other hand, the ecological coalition, although it was opposed, could not stop the extension of the industry to Magallanes. In particular, the NGO Ecoceanos was an active coalition actor in opposing the relocation of concessions in Magallanes. According to Aqua, Ecoceanos questioned the legal grounds of the proposal and explicitly pointed out once more the regulatory capture of the government by the salmon industry. However, the government pushed forward the relocation of concessions in Magallanes, arguing that the proposal was made considering the protection of sanitary and environmental aspects, and that the proposal was positively valued for the Aquaculture National Commission, a consultative body, created in 2012, in issues such as regulation affecting the salmon industry (Aqua.cl, 2013i).

The large set of regulations developed and implemented since the outbreak of ISAv in 2007, led some individuals to conclude that, after the ISA crisis, some aspects of the salmon production could become overregulated. A lawyer interviewed by Aqua explained that the regulations developed post-ISA crisis were excessive, and that the salmon activity passed from having a rather general regulation to an activity that was highly regulated. He pointed out that some of what was regarded as excessive regulation in the industry was likely to be the consequence of policy ambiguity. As a consequence, there were delays in implementing the policy instruments and procedures the new law (Law N°20434) mandated (Grupo Editorial Editec, 2012).

The following table summarises the conflict and ambiguity for the long-term policy responses.

Table 7.4: Conflict and ambiguity from long-term policy responses

		Conflict: - **Incompatibility of policy goals, interests, values, activities** - **Disagreement over means** - **Restriction of the behaviour of the addressees**	
		Low	**High**
Ambiguity: - **Misunderstanding and/or uncertainties in policy goals, instruments, instrument settings** - **Different interpretations of policy goals, scope and/or instruments** - **Misunderstanding and/or uncertainties in the role of actors** - **Uncertainty in capability and/or capacity and resources to reach policy goals and/or implement policy instruments** - **Ambiguity in policy language**	**Low**	- Self-governance of HMAs - Logistics of the new production model such as transport and ports - Fallowing of collection centres as part of the HMA model - Fixed fallow periods for all the species - Avoiding smoltification in lakes, rivers and estuaries - Norms with complex language - Lack of resources for smaller firms - Perception of the industry from other communities	- Relocation of concessions and the extension of the industry
	High	- Lack of resources and capabilities of the sanitary authority Sernapesca to control sanitary and environmental activities	- Modification of the LGPA - Revocation of concessions

Source: Own elaboration based on analysis, and Matland (1995) and Slembeck (1997) as theoretical base.

7.4. Evidence of industry policy learning and policy change

The most tangible evidence of a far-reaching policy change corresponds to the fundamental change in the industry production model, which involved a significant change from uncoordinated production to coordinated production. Moreover, tangible evidence of policy change in the industry to attain the new industry production model includes the new GLFA (Law N°20434), the updated sanitary and environmental regulations (RESA and RAMA respectively), the set of regulations and programmes (e.g. ISA Programme) enacted by Subpesca and Sernapesca that decree the measures to deal with ISA jointly with the voluntary measures of the industry, and the 44 measures applied by SalmonChile.

This evidence of sectoral policy change opens the discussion about whether this policy change actually enabled policy learning in the industry or not, and what the supporting evidence is for that answer. As said in Chapter 2, according to Birkland (2006), *prima facie* evidence of learning constitutes changes in policy, 'in a way that is reasonably likely to mitigate the problem revealed by the focusing event' (p.22); in this case changes in policy that reasonably alleviate the problem revealed by the sanitary crisis as the focusing event that illuminated the failures in the industry. In this way, the identification of learning seems to be a more or less straightforward task. However, it becomes a complicated one when there are strong disagreements on what the problem actually was as revealed by the focusing event, and then whether the changes made in policy mitigated it.

As was discussed in Section 5.2 the problems revealed by the sanitary crisis in the industry were understood differently by the two coalitions. For the neoliberal coalition the sanitary crisis revealed the deregulation of the industry that allowed the development of a fragile production model, which stopped a continuous growth in salmon production with financial consequences for producer firms. On the other hand, for the ecological coalition the sanitary crisis revealed the transgression of the limits of the ecology in which the salmon industry is immersed, expressed by permanent negative externalities produced by the industry.

Since the changes in policy entailed the development, delivery and adjustments of policy instruments, the creation of a stronger production model and the possibility to give concessions as real collateral that facilitate the financial relationship between the industry and the banking sector, it is fair to conclude that policy learning took place in the industry according to the arguments made by the neoliberal coalition. This interpretation is not supported by the ecological coalition, which argued that the changes made in policy did not address the ecological problems caused by the industry, and therefore it was not possible to conclude that learning took place. Instead, what the industry had was superstitious learning (a concept developed by May, 1992) via interventions of policy instruments with the belief that these new instruments actually solve the ecological problems. There was also mimicking behaviour (also used by May, 1992) through the creation of the Health Management Area Model with the belief that this new production model may solve the negative externalities (e.g. contamination) caused by the industry.

As an interviewed NGO said, the new model did not solve sanitary problems in the industry; it may have prevented some of them but, under this new HMA model, if there was, for example, a sanitary problem in which medications should be applied, all the firms in that specific area would apply the treatments together, which would result in a major contamination to the water.

However, the two coalitions agreed that one of the systemic failures of the industry was a policy failure translated as a hard institutional failure. As said previously, Birkland (2006) stated that learning has taken place when 'the proximate causes of the policy failure revealed by the event are subsequently addressed by changes in policy' (p.166). But again, the two coalitions understood the proximate causes of the policy failure differently. For the neoliberal coalition the proximate causes were understood as a lack of regulation to ensure production, whilst for the ecological coalition they were a lack of regulation to look after of the ecology, which includes the environment and the biological resource salmon.

Therefore, from the neoliberal view it is fair to say that learning actually took place since the changes in policy addressed the lack of regulation via much more regulation that targeted coordinated production. However, from the ecological view learning did not occur since the changes in policy tangentially addressed the care for the ecology in which the industry is immersed. Again, for the ecological coalition, it is seen as superstitious learning since the changes were made with little or no reflection on the continuous industry contamination and the way in which the salmon is produced, even when some considerations, such as the use of antibiotics and animal welfare, were included in regulations.

Although radical policy change did not occur because there was not a shift in the policy paradigm of the industry from a neoliberal paradigm to an ecological paradigm, and the learning in policies was not sufficient to balance the neoliberal and ecological paradigms of the industry, the industry regulatory framework is gradually progressing in an ecological direction.

For now, this ecological direction taken by the industry is more a means than an end to still support the neoliberal paradigm. However, as some interviewees reported, it is likely that another sanitary crisis should be expected soon, which may be caused by pathogens other than the ISA virus (e.g. Salmon Rickettsial Syndrome -SRS). This new sanitary crisis will serve as a new opportunity to position the ecological view in policies.

The following table shows evidence of learning during the process of design and delivery of policy responses and regarding the consequences caused by those policy responses.

Table7.5: Typical evidence of learning in the policy process of the Chilean salmon industry

Actor	Evidence of Learning	
	During the design and delivery of policy responses	**Regarding the consequences of policy responses**
Media	- Daily news and considerable coverage in national media newspapers such as Estrategia, El Mercurio, La Tercera and La Segunda, and especially from the specialised aquaculture media, Aqua (Technopress) - International media coverage from, for example, New York Times and FIS	- News about the effects of the updated industry regulatory framework, especially the HMA model for producers and suppliers, the negotiations between the industry and the banking sector, and the recovery of the industry
Interests groups	- Different actors (e.g. NGOs, producers, banking sector) going to the Congress to negotiate policy responses - Researchers interviewed during the policy reform - Development of the voluntary and 44 measures applied by SalmonChile	- Briefs and information on the websites of NGOs, SalmonChile and Acotruch - Interests groups such as Acotruch and supplier associations negotiating the implementation and adjustment of policy responses with the government
Policy makers	- Senators and Deputies working a year and half in modifying the GLFA N°18892	- Debates on the problems in implementing the policy responses
Regulatory and implementing agencies	- Sernapesca and Subpesca working on the modification of the GLFA, sanitary and environmental regulations, and developing new measures to deal with ISA (e.g. ISA Programme) - Other actors related to the aquaculture sector such as the Ministry of Economy, Marine Undersecretary, National Environmental Commission, Agency for Economic Development and Fundación Chile participating in the development of policy responses	- Bureaucrats (i.e. Sernapesca and Subpesca) implementing the policy responses

Source: Own elaboration adapted from Birkland (2006) and based on data.

7.5. The closing of the policy window and the 'recovery' of the industry with an endemic ISA

The closing of the policy window in the industry occurred with the approval of the new GLFA (Law N°20434) in April 2010. At that moment the HMA model was, although partially, already implemented, and adjustments through incremental upgrading were occurring to make the model more technically and politically feasible. Moreover, the worst part of the crisis had passed and the virus was already under control; ISA outbreaks and salmon mortality (i.e. the problem that opened the policy window) were no longer as relevant as before. ISA outbreaks had been mainly due to the virulent strain of ISAv (i.e. HPR0), which does not cause the clinical disease. One case of HPR2[60] was detected in Aysén (Sernapesca, 2013).

The development and delivery of the new industry regulatory framework to deal with ISA was made, and the government believed that they had addressed the sanitary crisis through the upgrading of industry regulations. This belief was supported by the gradual increase in the Chilean salmon production: this increase was achieved through an increase in the salmon biomass. According to Sernapesca (2013), in 2012, the industry reached a biomass level higher than 2007 and 2008 (the beginning of the sanitary crisis); however, the distribution was different. Aysén Region registered 52.88% of the total biomass, whilst Los Lagos and Magallanes Regions registered 43.05% and 4.15% respectively. For Aysén and Magallanes the more recent production was historically their maximum levels of biomass.

This shows the interest of the industry in producing salmon in the southern regions, other than from Los Lagos (where the activity started) and the extension of the industry to those places. For example, until 2012, there were 198 concessions granted in Aysén, and between June 2011 and March 2012 there were 148 applications (Aqua.cl, 2012d).

Between 2011 and 2012 there was an increase of biomass at the national level of 31.92%. Aysén and Magallanes Regions registered a higher increase in the biomass compared to Los Lagos (13.15%), with 52.39% and 33.48% respectively. In 2012 at the national level, Atlantic salmon was the most cultivated specie with 61.35% of the total biomass, followed by rainbow trout with 24.49% and Coho salmon with 14.02%. In Los Lagos Region 45.10% of the biomass corresponded to Atlantic salmon, 30.94% to rainbow trout and 23.64% to Coho Salmon. In Aysén Region 72.68% corresponded to Atlantic salmon, 20.03% corresponded to rainbow trout and 7.29% to Coho salmon. In Magallanes, 85.76% corresponded to Atlantic salmon and

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[60] A more virulent strain than HPR0 of ISAv.

14.24% to rainbow trout, whilst in this region there is no cultivation of Coho salmon (Sernapesca, 2013).

In 2011 the harvested biomass of Atlantic salmon and Coho salmon was 264,000 tonnes and 160,000 tonnes respectively. This was 53.4% and 17.23% more than 2010 (Grupo Editorial Editec, 2013b). As a consequence of this there was an increase in the global salmon production, which produced a decrease in the international prices and affected the finances of the local firms. In 2011 at the global level, there was a decrease in the price of salmon of about 30%; this was due to the production of Chile that reached a peak of 804 tonnes (Aqua.cl, 2013h).

In 2012, an increase in production that was achieved through an increase in the biomass again caused a deterioration in the sanitary conditions of the industry, although not at the levels of the ISA crisis. However, there was a significant increase in the infestation of farms due to caligus, and an increase of mortality due to Salmon Rickettsial Syndrome (SRS) (Grupo Editorial Editec, 2013b).

Comparing 2011 with 2012, there was an increase in the average load of total adult caligus from 2.4 to 3.28. Aysén was the region registering the highest increase (from 2.43 to 3.94): Los Lagos Region had a smaller increase from 2.31 to 2.45 (Sernapesca, 2013). According to Sernapesca (2013), the increase in the biomass of the susceptible species and the density are the most strongly associated factors with the increased parasite loads. The susceptible species for caligus are the Atlantic salmon and the Rainbow trout, whose biomass was increased by 38.32% between 2011 and 2012. Aysén has been the most affected region.

In terms of mortality, the following figure shows the percentage of mortality in 2011 and 2012 at the national level. It can be appreciated that, excluding the months of July, August and October, there was an increase of mortality in 2012. In 2012 the main pathology causing mortality for Atlantic salmon, Coho salmon and rainbow trout was piscirickettsiosis (SRS) with 69.4%, 60.3% and 94.6% respectively (Sernapesca, 2013).

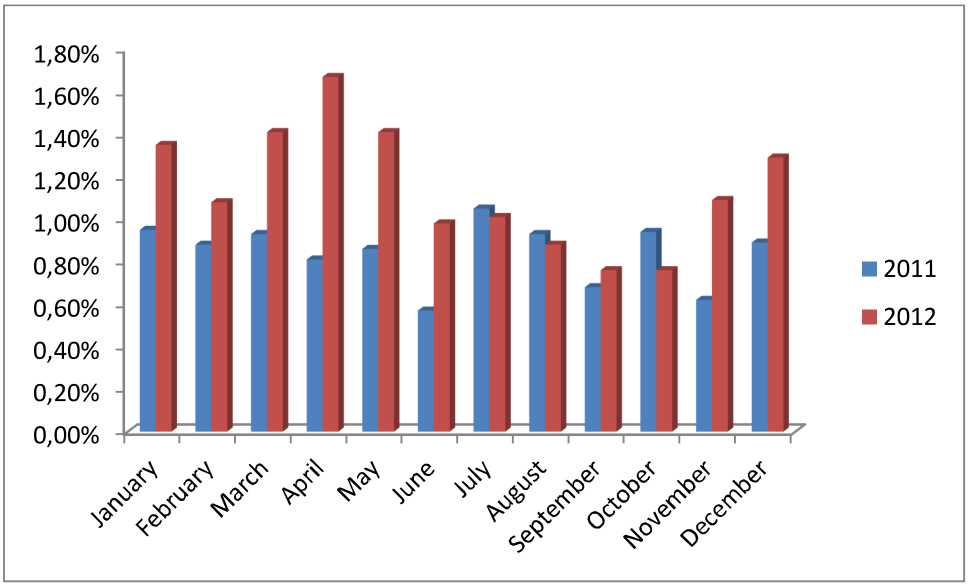

Figure 7.1: Percentage of salmon mortality in 2011 and 2012 at national level.
Source: Sernapesca (2013).

This deterioration in sanitary conditions increased the costs of the firms, and the local industry was again facing an adverse scenario. As the majority of the interviewees reported, the policy learning and policy change of the industry helped everyone to realise that the new regulatory framework of the industry could not guarantee the avoidance of a future sanitary crisis. However, it could reduce the risk of having a future crisis or the magnitude of that crisis. The learning processes also reinforced awareness in the actors about how the industry works with biological species that are unpredictable, and that a crucial element to avoid a future crisis is to have adequate practices in order to take care of the natural resource water and the biological resource salmon.

The continuous improvements and the creation of new policy instruments demonstrates a dynamic policy learning in the industry that will be accelerated again with the next crisis that can be sanitary, financial or of some other nature.

7.6. Synthesis of the chapter

In the Chilean salmon industry there were short and long term consequences of the policy responses to the sanitary crisis. These consequences were caused by the increasing influence of the ecological paradigm on the industry policy learning and policy change, the influence of the new industry association, Acotruch, over production policy issues, and the policy responses to the structure of the industry. The consequences were analysed from a conflict and ambiguity policy perspective because it combines political and technical elements allowing a further analysis of policy learning.

The consequences of the immediate and short-term policy responses were the conflict and ambiguity in the process of the design of those responses, and the conflict and ambiguity in reducing those responses into practice. The ecological view needed to solve the policy problems that were framed in a neoliberal perspective, and the divergent narratives that illuminated the causes of the crisis explained the conflict and ambiguity in the design of the responses. The difficulties of putting the policy into practice were the principal agent problems between the legislative and bureaucrats, and between the bureaucrats and addressees, and the technical and political infeasibility over policies.

The incremental long-term policy responses led to the attempt to reduce the policy conflict and ambiguity through changes and adjustments of the policy instruments and their settings. The most controversial policy response in terms of conflict and ambiguity was the proposal of the new industry production model, which constituted a fundamental change for the production of salmon. Once implemented, the model introduced substantial ambiguity and conflict. This is because it created a new industry structure that revealed the need for an ecological perspective over policy issues and the success of minority industry actors who were able to influence the production organisation.

In terms of evidence of policy learning and policy change, the most tangible evidence of a far-reaching policy change corresponded to the fundamental change in the industry's production model, which involved a significant change from uncoordinated production to coordinated production. Moreover, tangible evidence of policy change in the industry in attaining the new industry production model included the new Law of Fishing and Aquaculture, updated regulations, a new set of regulations and programmes to deal with ISA and measures of the industry.

This evidence of sectoral policy change opened discussions about whether this policy change actually enabled policy learning in the industry or not. From a neoliberal view, policy learning took place because the changes in policy mitigated the problems revealed by the crisis. However, from an ecological view, since the changes made in policy did not address the ecological problems caused by the industry, it was argued that it was not possible to conclude that learning took place. The ecological coalition claimed that what took place was superstitious learning via interventions of policy instruments, with the belief that these new instruments actually solved the ecological problems, and mimicking behaviour through the creation of the new production model, with the belief that the model may solve the negative externalities caused by the industry.

The development and delivery of the new industry regulatory framework to deal with ISA was made, and the government believed that they had addressed the sanitary crisis through the upgrading of industry regulations, and, with the approval of the new Law of Fishing and Aquaculture in 2010, the industry policy window closed. This belief was supported by the gradual increase in Chilean salmon production. This increase was achieved through an increase in the biomass, which caused a further deterioration in the sanitary conditions of the industry and increased the costs of the firms.

Although radical policy change did not occur because there was not a shift in the industry policy paradigm from a neoliberal paradigm to an ecological paradigm, and the learning in policies was not sufficient to balance the neoliberal and ecological paradigms of the industry, the new industry regulatory framework is gradually progressing in an ecological direction. The majority of the interviewees reported that the policy learning and policy change of the industry helped everyone to realise that the new industry regulatory framework could not guarantee the avoidance of a future sanitary crisis. However, it could reduce the risk of having a future crisis or the magnitude of that crisis. The learning processes also reinforced an awareness in the actors about how the industry works with biological species that are unpredictable, and that a crucial element to avoid a future crisis is to have adequate practices in order to take care of the natural resource water and the biological resource salmon.

CHAPTER 8

CONCLUSIONS

The first section of the concluding chapter revisits the research problem, research questions, data, information and methodology. The second section summarises the main findings of the study and discusses the substantial contribution to knowledge and generalisation this research makes. The last section outlines some limitations of the study and possible future work.

8.1. Revisiting the research

8.1.1. Research problem

The research problem of this thesis is concerned with the timing, steps and forms by which policy changes and adapts to respond to catastrophic events such as the sanitary crisis of the Chilean salmon farming industry. In the process of policy learning and policy change related to dramatic events, it is particularly relevant to differentiate radical changes from more incremental ones because those changes accompany the features of the phases that catastrophic events exhibit.

The Chilean salmon farming industry is the second largest producer and exporter of farmed salmon in the world after Norway. The sanitary crisis due to ISAv (a virus that kills salmon) during 2007 and 2010 was not just a localised problem but a global one. In 2006 the Chilean industry accounted for 38% of global salmon production, which dropped by 25% in 2010 due to the decrease in the Chilean production. The sanitary crisis in the Chilean industry produced a turning point in the industry evolution. It paved the way for the update of the sector's regulatory framework, which was demonstrated to be ineffective in protecting the industry from diseases such as ISA.

After the sanitary crisis, industry policy changed and rapidly adopted the best practice models of other global salmon producer countries, who experienced the same sanitary crisis long before Chile. In the short-term, the policy introduced potentially radical changes, of which the development and implementation of the new production model was the most fundamental. In the long-term, the policy changed incrementally to adjust to the potentially radical changes. The changes in the industry paralleled the phases of the sanitary crisis that evolved over time.

The argument is made in the thesis that the potentially radical and incremental policy responses to the sanitary crisis in the Chilean industry produced different consequences in the short and long terms for industry participants and society (e.g. local environment, jobs). Those consequences were influenced by the conflict and ambiguity introduced by the policy responses that stimulated further adaptation and update of the industry policy.

8.1.2. Research questions

Within the context of the sanitary crisis of the Chilean salmon farming industry, this thesis posed three research questions.

First research question:

How do industry natural resource crises precipitate processes of policy learning and policy change?

This research question is formulated to investigate the timing in which changes in policy occur stimulated by dramatic events. This involves investigating how the policy changes are accelerated by those events and is therefore related to the time in which policy changes in the policy making process occur.

Second research question:

How are policy responses stimulated by industry natural resource crises developed and implemented?

This second research question aims to understand better the steps and forms that policy responses to catastrophic events take, how they are formulated and delivered. To do so, it is crucial to link those responses with the evolutionary phases of catastrophic events since each phase exhibits particular features that the policy should attend.

Third research question:

What are the consequences of policy responses stimulated by industry natural resource crises for industry participants and society (e.g. local environment and jobs)?

The aim of this third research question is to investigate the effects and results that policy responses to catastrophic events have on different industry participants and society, such as the local environment and jobs. Policy responses will have different effects due to the diversity of industry actors in terms of their distinct interests, understandings, values and positions in the industry.

To answer these research questions, two bodies of literatures were employed: i) policy learning and policy change, and ii) crises and disasters management. The combination of these two bodies of literature provided the lens through which the data and information could be viewed to analyse the research questions.

8.1.3. Data, information and methodology

The empirical research of this study was mainly based on 82 interviews with producer firms, bureaucrats, NGOs, associations and the banking sector to name but a few. Those interviews gathered information from a complete set of industry actors on the causes of the sanitary crisis in the Chilean salmon farming industry, the policy responses reacting to the crisis, and the consequences of those policy responses. Information on these topics allowed for analysis on the nature of the sanitary crisis in Chile, how the policies were updated via changes and adaptations due to the crisis, and the effects of these policies for industry actors and society. In addition, industry and government quantitative and qualitative data were gathered from industry, government, firms, NGOs and associations reports.

To answer the research questions, this thesis employed a qualitative approach. Data and information was put in chronological order according to the events that occurred in reality. The research questions followed this chronological order. The first research question is related with how the sanitary crisis pushed and started a policy learning process. This event was followed by the development and delivery of policy responses to respond to the crisis (second research question). These responses had consequences for industry participants and society that are related to the third research question. The causal relationships between policy learning, changes in policy goals, policy instruments, and the settings of those policy instruments in the three research questions, were clarified by the chronological scheme since it is clear that the sanitary crisis was followed by policy responses that were preceded by effects or results of those responses.

To analyse how a crisis precipitates processes of policy learning and policy change in the salmon industry (first research question), narratives of the sources of the crisis were used as an analytical technique. The causal link between the event of the industry sanitary crisis and the beginning of the process of policy learning and policy change was made. There is a strong link between these two events since the study demonstrates that industry policies changed to deal with the crisis and its effects. To answer the second research question, which is related to how the policies respond to the industry crisis, the link between the features of the evolutionary phases of the crisis and the responses was made to analyse the nature or form of the response (i.e. more radical or more incremental responses). Also, it was observed how policies changed and evolved over time to satisfy the needs of each phase of the crisis.

To answer the third research question, which deals with the effects of the policy responses to different actors, the link between the policy responses and their effects was made. Also, a 'time-series analysis' was made looking at how the policies were adapted over time to deal with the ineffective or unwanted results the responses caused. The 'constant comparative method of comparison' among the interviewees' responses, and the 'deviant case analysis' to include information relevant to the study, such as the departure of the Coho salmon and trout producers, were used to answer the three research questions.

8.2. Main findings, contribution to knowledge and generalisation from this research

This thesis contributes theoretically, methodologically and empirically to knowledge in the following ways:

8.2.1. Theoretical contribution

This research contributes theoretically to the literature of policy learning and policy change in four ways. The first theoretical contribution refers to the discussion of the implications of crises to the policy learning and policy change literature. In the literature of policy learning and policy change, the characteristics of crises have not been considered and linked to policies responding to those events in an institutional learning process.

The second theoretical contribution considers the causes of crises in defining policy problems. Considering the work of Penning-Rowsell, Johnson and Tunstall (2006) on crises as policy change accelerators. We argue that crises can also be considered as policy learning precipitators. Crises are powerful events that accelerate processes of policy learning.

The third theoretical contribution extends the view of the policy learning and policy change literature on dramatic events such as crises, considering them as dynamic and persistent situations. The literature views these events as stagnant situations. It means that catastrophic events such as crises do not evolve over time (i.e. they do not have different stages). This limits the analysis on policy responding to dramatic events because the responses may not be linked to the phases of crises since the literature does not take these phases into account. It also gives a static analysis of policy learning processes and the nature of radical and incremental changes in policies may not be known in detail.

The fourth theoretical contribution regards the role of catastrophic events such as crises in creating opportunities for radical policy change. The existing literature on policy learning and policy change refers to radical policy change and the potential of catastrophic events as accelerators of radical policy change, however, it does not analyse in detail the timing or steps by which radical policy change is likely to occur after a dramatic event. The literature refers to radical policy change as paradigm shifts. In this view, and as Hall (1993) indicates, overarching goals that guide policies in a particular field are altered. Crisis response is an atypical type of policy change whose origins are found outside the formalities and routines of the policy-making process (Howlett, Ramesh and Perl,2009). Catastrophic events challenge the prior decisions taken by formal policy-making processes and may require radical policy change. However, since the existing literature adopts the limited view of catastrophic events as transient situations, it does not analyse their potential as precipitators of radical policy change, nor provide a means for considering the timing and processes by which this radical policy change may occur.

Moreover, a theoretical contribution is made to the system failure approach and it is related to the link made between all the failures of the system failure approach identified in the study, and not the consideration or identification of one type of failure as Woolthuis, Lankhuizen and Gilsing (2005) did. Also, adding the ‘unexpected failures’ category to the system failure approach in the innovation literature to be taken into account in studies related to ecology and natural resources is a contribution. This contributes to the system of innovation literature, specifically the system failure approach.

A policy conclusion arising from the extension of the theoretical framework used in this thesis to consider the role of crises in policy-making, is to build a bridge between the policy learning and policy change literature and the literature relating to crises and disasters management. The principal features of this bridge are, a) an understanding of the roles of the catastrophic events, b) an understanding of how catastrophic events create opportunities for radical changes and learning in policies, c) how the dynamic, enduring and persistent features of catastrophic events result in policy learning and policy change evolving through different stages, paralleling the evolution of the catastrophic events themselves, and d) an understanding of the elements or processes that emerge at each stage in the policy-making process. By bridging these two literatures it is possible to identify strategies by which policy-makers may design immediate and short-term responses that simultaneously take into account both short and long term consequences. This might be done by anticipating the demands that crises may cause, and framing the policy-making process to be more robust to demands that are not initially present but can, in outline, be anticipated to emerge in later stages of the process. Immediate responses that address these issues might help to reduce the magnitude and effects of catastrophic events, and may help to anticipate and prevent future dramatic events. This thesis has demonstrated this using the sanitary crisis of the Chilean salmon farming industry as a case study.

8.2.2. Methodological contribution

This thesis makes two methodological contributions. The first methodological contribution is the in-depth analysis of a single industry-country case study. It gives the opportunity to observe in detail and comprehend the dynamic among industry actors over policy issues that cannot be observable using a more general approach, for example, the comparison between two industries in different countries such as the comparison between Chile and Norway, the two countries competing for first place in producing and exporting farmed salmon at the global level. This analysis extends the policy learning and policy change literature adding new empirical understandings on the dynamics of the salmon industry. The dynamic is related to the heterogeneity of the industry in terms of different actors, with distinct understandings, interests and beliefs cultivating a variety of species that have distinctive biological features, who should decide over policy issues of the whole industry.

The second methodological contribution is related to the holistic approach adopted by the research in which a complete set of industry actors was considered as opposed to more narrow methods that just consider the behaviour of firms, for example. The approach also involves the causality of different events and their analysis as a whole, as opposed to isolating them. For example, only considering the isolated case of the sanitary crisis of the industry, or considering the isolated case of the policy responding to the sanitary crisis, or considering the isolated case of the effects of those policy responses. The holistic approach enriches the literature on policy learning and policy change, providing a more complete view of the evolution of an industrial regulation policy.

8.2.3. Empirical contribution

This thesis has contributed to an understanding of how policy learning and policy change takes place in the context and aftermath of a self-made natural resource industry crisis. We took the Chilean salmon farming industry that suffered a catastrophic crisis as a consequence of the ISA virus between 2007 and 2010. The findings are presented following the order of the three research questions investigated in Chapters 5, 6 and 7.

Empirical contribution of the first research question

The first research question asks how catastrophic industry events accelerate policy learning and policy change processes. The main contribution of this research question is to demonstrate that, in the case of the salmon industry in Chile, the industry sanitary crisis was an exogenous stimulus that disrupted the industry governance processes, including the industry's regulatory framework opening a window for potentially radical institutional change. During the first stages of the sanitary crisis, the industry governance processes, including the industry's regulatory framework, were disrupted. The crisis proved that the way in which the industry was operating was no longer viable and that something urgent and radical was needed to address the causes of the crisis. Therefore the crisis revealed the inherent problems.

The second finding is that the sanitary crisis in the Chilean industry revealed evidence of policy failure in several ways. It was shown that the initial industry regulatory framework was inadequate in protecting the industry from a virus that was not new in the world, nor was it effective to deal with and control it. ISA virus was unknown (at least in scale) for the Chilean industry, and the regulatory framework at the time of the crisis had not adequately incorporated in its goals specificities of this virus. Therefore no measures to protect the industry from this virus were implemented before the crisis. The solution to solve the industry's sanitary crisis and its effects could not be achieved using the initial regulatory framework; therefore updates and modifications in this framework were needed. For example, part of the solution to solve the crisis involved an upgrading in the coordination of salmon production in order to attack sanitary (e.g. fish diseases) and environmental (e.g. cleanliness of water) problems in a coordinated way. The initial industry regulatory framework was adequately designed to protect the industry from other known hygienic problems but it was inadequately implemented. This ineffective implementation allowed the development of conditions that stimulated the crisis in the Chilean industry. The industry was unable to anticipate sanitary problems due to ISAv, and therefore the industry should modernise its warning, control and mitigation systems, introducing modifications in the settings of the regulatory framework and its instruments in order to make them more adequate and effective to the new needs and challenges of the industry.

The third finding is that when the policy window was opened a variety of understandings, interests and beliefs emerged that influenced the development and delivery of policy responses to the crisis. There were multiple interpretations about the conditions that stimulated the crisis in the industry, and discrepancies in expert opinion about whether the initial regulatory framework prior to the crisis was adequately designed to protect the industry. These multiple interpretations and discrepancies produced conflicts in the diagnosis of the problems revealed by the crisis, including the failures of the initial regulatory framework that influenced the ordering and outcome of policy deliberations and the resulting adopted measures as policy responses to the crisis.

A fourth finding is that the sanitary crisis in the Chilean salmon farming industry renewed the historical conflict between the industry and NGOs on the poor sanitary and environmental conditions in which the industry was operating, and it also showed the different interests among industry actors. The conflict shaped the policy learning and policy change processes of the industry. It also enlightened the heterogeneity of the industry and the diversity of interests among industry actors that, in normal times, are restrained. Throughout the history of the Chilean salmon industry, the number and variety of ideas, interests and beliefs has been increased by the entrance of new actors into the industry, for example, NGOs. Ideas, interests and beliefs about environmental care and sustainability (proposed mainly by NGOs) added to the ideas, interests and beliefs on profit maximisation and levels of exports (proposed mainly by producers) more strongly over the last ten years. The level of conflict regarding environmental issues was increased by the entrance of NGOs into the industry.

The fifth finding is that the conditions that stimulated the crisis in the industry were interdependent and an industry system failure was observed. Prior to the crisis some actors, such as NGOs, researchers, associations, trades unions and veterinarians, were warning that an intensive production model, together with a lack of or an ineffective regulation and a lack of scientific knowledge to make decisions sooner rather than later, would produce a catastrophic event in the industry. However, those voices were ignored up until the point of the crisis.

Empirical contribution of the second research question

The main contribution of the second research question is to demonstrate that the sanitary crisis in the Chilean industry was neither transient nor episodic, but was enduring, persistent and dynamic. This was due to the fact that it was caused by a biological agent that was impossible to eradicate, and which, once introduced, made the industry chronically vulnerable. This finding is different from those reported by Kingdon (2003) and Birkland (2006), who consider catastrophic events such as crises as focusing events that last for a short period of time.

Second, the thesis demonstrated that the sanitary crisis of the Chilean salmon industry did not produce a radical policy change. Potentially radical measures were part of a set of policies that emerged as initial responses during the first stages of the crisis. They included the fundamental change in the industry production model and the development of new regulations to control the virus. New ideas that prior to the crisis were ignored were now considered, such as the enforcement of a period without salmon in the water to allow it to recover after a production cycle (i.e. fallowing) and to impose fish density limits. After the potentially radical measures were proposed, and during the later stages of the sanitary crisis, a set of more incremental policy responses was developed and applied. The incremental policy change was aimed at attending to the non-urgent needs of the industry and reducing the conflict and ambiguity caused by the potentially radical policy response. Policy responses were guided by the features of crisis stages.

The third finding is that, in the case of the Chilean salmon industry, the policy responded directly to the crisis and less directly to past policy and new information, such as the sanitary and environmental conditions of the industry prior to crisis. This contrasts with Hall’s (1993) definition of policy learning in which it is indicated that the adjustments of goals or techniques in policy respond to past experience and new information. The policy learning process triggered by the crisis was demonstrated to be reactive rather than proactive.

The fourth finding is that, to solve the sanitary crisis itself (first stages of the crisis), the industry adopted a positivist 'best practice' model of policy learning (a concept used by Freeman, 2006), and therefore experiences from other places and times were transferred and adapted to the Chilean context. The industry's new production model (i.e. health management areas model) was inspired by the Canadian experience, and international experts were participating in plans and actions developed and adopted by the local industry. To update the industry regulatory framework (in the later stages of the crisis) a more constructivist approach of policy learning (a concept used by Freeman, 2006) was adopted, and therefore the new policies, including the Law N°20434 resulting from the policy response process, emerged as a collective process of knowledge accumulation from the interaction and participation of different actors.

From an actor perspective, the fifth finding show that there was agreement among actors about the need to modify the industry's regulatory framework, but strong disagreement about what aspects of this regulatory framework should be modified and how these aspects should be modified. This situation generated conflict in the industry's policy learning process. Moreover, in the learning process, new actors emerged during the development of policy responses, for example, the banking sector and the new Association of Coho Salmon and Rainbow Trout Producers.

Empirical contribution of the third research question

The main finding of the investigation of the third research question is that the policy responses to the sanitary crisis destabilised the consensus in the Chilean salmon industry causing conflict. The conflict was demonstrated to be an important driver in the policy learning and policy change processes of the industry. After the crisis, industry actors could not agree on how to solve the crisis and its effects. Although the policy response process was a participatory one and was made through consultation, there were disagreements on the proposed responses and favouritism to some actors (e.g. Atlantic salmon producers); there was no agreement of all the actors. The strong disagreements and the new regulatory framework, which did not represent a consensus to the interests of all actors, led to the organisational fission of the Association of Salmon Industry; this caused the emergence of a new and parallel Association with the dissidents of the Association of Salmon Industry as a new industry actor.

Some actors (who are a minority in the industry) were marginalised in the deliberation process of policy reform. At the same time, the disruption of the industry governance processes, including the initial regulatory framework of the industry, allowed the opportunity to change or reorder the interests, priorities and power of involved actors. For example, smaller producers of a less significant species pushed the policy change process in a different direction than what was decided earlier.

The second finding is that the state was unable to anticipate detrimental consequences of the measures adopted because of this marginalisation or exclusion of these actors. The result was an ineffective policy that provoked a call for further reform by lobbying and political pressures aimed at taking a different course than the initial measures that were adopted.

Third, during the first stages of the crisis there was substantial ambiguity about its causes, the effectiveness of policy responses and the consequences of these responses. A clear example is that there were some difficulties in reducing the new regulatory framework into practice and to implement it in the same way as was intended. Reasons for this were the conflicts generated by the adopted measures (i.e. some actors disagree with some measures), the ambiguity of the means of implementing some measures (e.g. lack of resources for Sernapesca to control the industry through sanitary inspections more), and the infeasibility because of impractical points of the new law and regulations (e.g. fallowing periods of farming centres that do not match with the production of some salmon species).

A fourth finding is that since the new regulatory framework proposed potentially radical changes in the industry, it had to operate in a different way compared with prior to the crisis. A new system had to be developed that required new understandings, priorities, beliefs and agreements. The establishment of this new system created a contested process involving new discussions and efforts to negotiate the implementation of, and adjustments to, the new regulatory framework.

In synthesis:

From the above account we argue that, in the earlier stages of catastrophic events, it is expected that more potentially radical than incremental policy change occurs. This is due to the fact that in those stages where the governance processes are disrupted, there is more fluidity and urgency of action, policy failure is proven, conflict among actors is renewed, consensus among actors is destabilised, ambiguity on policy issues arises, and new actors and new ideas emerge. A dynamic is created that interrupts the more common incremental process of policy learning.

The significance of this thesis therefore lies in integrating new understandings and evidence of policy learning and policy change processes in the context of catastrophic events into the existing policy learning and policy change literature. Above all it argues that the process of policy learning and policy change in the context of catastrophic events is very different from the processes of policy learning and policy change in normal times.

We can also conclude that, while the literature does refer to crises as catastrophic events that may accelerate catalytic policy change (e.g. Penning-Rowsell, Johnson and Tunstall, 2006), it does not refer in detail to the feature of crises as being dynamic, evolving and persistent events and the consequences of this feature. On the contrary, the literature treats these events as transient and episodic. For example, Kingdon (2003) and Birkland (2006) consider catastrophic events as focusing events that last for a short period of time, focalising the responses to them to the immediate and short-term periods.

However, the chronic feature of crises as something that is more persistent and continual, and makes it necessary to be constantly updating the knowledge and policy responses to these events. This view changes the perspective of the responses and the actors need to think in the long-term, taking into account the vulnerability that the crisis created.

Biological crises caused by biological agents (such as viruses that may mutate) always constitute a risk for potential future crises. This feature is aggravated when the resources involved correspond to those called common-pool resources. This is due to the spillovers of the problems caused by the crisis and because the policy responses to them may expand the consequences to a larger range of actors.

On the other hand, policies responding directly to a crisis and less directly to past policy and new information tend to be reactive and solve the particular problems emerging from the crisis. This may occur because resources (e.g. time, money, personnel) can be limited or there are political pressures (e.g. an electoral year) to show solutions. However, this also shows a short-term vision in policy making, where the opportunity to anticipate or reduce the magnitude of future crises is limited.

The aim of this thesis has been to better understand how policy responds to catastrophic events and how policy changes and adapts after a catastrophic event. Thus, this thesis critiques the existing literature by linking the policy learning and policy change literature with the literature on crises and disasters management to introduce critical questions of stages of change to the outcomes of policy change

This linkage offers novel insights on policy learning, policy change and dramatic events as processes that co-evolve. Literature relating to crises and disasters' management indicates that catastrophic events evolve from a critical period of urgency to a period in which normality is restored (Faulkner, 2001). Policy learning and policy change literature may benefit from this contribution when thinking about catastrophic events as dynamic, enduring and persistent, and not just as transient disturbances or episodic. The adoption of this perspective allows thinking about policy responses as an evolutionary process in which policies may react differently according to the distinct evolutionary stages of catastrophic events, and thus respond through more radical or incremental changes according to the particularities of each stage.

8.3. Limitation of the research and future topics to explore

The use of a single industry-country case study can limit our ability to make inferences to other contexts. Although it was argued in Section 4.4 that it is incorrect to conclude that it is not possible to generalise from an individual case, generalisations from using single cases (such as this research) must be made with caution. This caution refers to the 'correct' identification of the attributes and the relevance of the attributes of the case study. However, it has to be understood that this claim is grounded in the premise that the case chosen is not an outlier or idiosyncratic case of a general phenomenon. In this thesis, the under-development of the literature on policy making in response to crisis makes it difficult to claim that the case of the policy response to the sanitary crisis in the Chilean salmon farming industry is free of idiosyncratic features that might limit its generalisation. This means that the scope for comparison is limited.

Another limitation of this research is that the interviews were designed to gather information about the changes and updates in rules, policies and regulations that followed the sanitary crisis in the industry, but did not pursue in depth and gathered little information about changes in the actual industry practices. The explanation for this is that the aim of the research was to explain how and why changes in the regulatory framework of the industry were made stimulated by the industry sanitary crisis. The fieldwork took place exactly a year after the approval and publishing of the modification of the General Law of Fishing and Aquaculture (Law N°20434), which framed and drove the changes in rules and regulations responding to the crisis. A year of implementation is too early to state how the actual industry practices have changed, because during this period the adjustments of the newly implemented law (Law N°20434) or policy responses were taking place.

Even with this qualification or reservation, it is important to point out that assessment in the changes of industry practices must be carefully related to what was the actual role of the regulation in these changes. This should take into account not just the mechanisms (and their limitations) of enforcing and controlling industry practices, but also the interests and preferences of the addressees that could be inconsistent with the goals and means of the regulation, and the capacity and resources the regulated firms have to comply with the regulation. Future research might involve providing further empirical insights into industry practices. This thesis can serve as a basis for that future research.

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APPENDICES

APPENDIX A

LIST OF INTERVIEWS CONDUCTED FOR THIS RESEARCH

This appendix displays the list of the 82 interviews conducted to gather primary data collection during the single episode of fieldwork from April to July 2011.

The geographical distribution of interviews was: 31 were in Santiago (capital city), 38 were in Puerto Montt (637 miles from Santiago), 11 were in Valparaíso (73 miles from Santiago), 1 was in Puerto Varas (14 miles from Puerto Montt) and 1 was in Castro, Chiloé Island (108 miles from Puerto Montt).

All interviewees were key people for the Chilean salmon industry, sanitary crisis in the industry, policy responses to the crisis and their consequences, at the time of this research. Among the interviewees were, for example, the person who reported the virus in 2007, a manager of the firm which reported the virus in 2007, the person who wrote the project law which was discussed at the Congress, the political head of the process of modification of the law, the head of the Fishing Commission in the Chamber of Deputies at the Congress, the head of the Fishing Commission in the Senate at the Congress, dissidents of the process of modification of the law, presidents of associations, chief executives of firms and several authorities such as the Undersecretary of Fishing and Aquaculture.

At the time of the fieldwork some interviewees were working in the consultancy sector but when the crisis arose in the industry they were authorities or relevant people at that moment.

The interviews were grouped into the following 10 actors:

Bureaucrats: 6 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Alicia Gallardo	Head Aquaculture Unit	National Fishing Sector	8 June	Valparaíso
Branny Montecinos	Head Aquaculture Unit	National Fishing Sector (X Region)	26 May	Puerto Montt
Jessica Fuentes	Legal Adviser	Undersecretary of Fishing	5 May	Valparaíso

José Miguel Burgos	Head Aquaculture Division	Undersecretary of Fishing	9 May	Santiago
Pablo Galilea and José Miguel Burgos	Undersecretary and Head Aquaculture Division, respectively	Undersecretary of Fishing	26 July	Valparaíso
Verónica Guzmán and Heriberto Ceballo	Head of Fishery Management Programme and Professional of Fishery Management Programme, respectively	National Fishing Sector (X Region)	26 May	Puerto Montt

Public Agencies, Programmes, Institutes, Councils and Services: 11 interviews

Interviewee	**Position at the time of the interview**	**Organisation at the time of the interview**	**Date of the interview**	**Place of the interview**
Alfredo Fröhlich	Regional Director (X Region)	Agriculture and Livestock Service	23 May	Puerto Montt
Carlos Vial	Representative of Trade Unions Business Sector X-XII Regions	National Fisheries Council	6 June	Santiago
Gonzalo Romero	Former Manager	Salmon Cluster (Integrated Territorial Programme)	18 May	Puerto Montt
Héctor Vera	General Manager	Serv. Acuicolas Paguro EIRL EcoverdeLtda SalmodiversLtda	21 May	Puerto Montt
Hugo Escobar	Development and Innovation Executive Regional Direction Chilean Agency for Economic Development Los Lagos (X Region)	Chilean Agency for Economic Development	21 May	Puerto Montt
Leonardo Guzmán	Head of Aquaculture Research Division	Fisheries Development Institute	13 May	Puerto Montt

Rafael Lorenzini	Executive Director	National Council for Clean Production	21 July	Santiago
Romilio Espejo	Academic Staff	Institute of Nutrition and Food Technology University of Chile	13 April	Santiago
Sandra Silva	Regional Director (X Region)	Export Promotion Bureau	17 May	Puerto Montt
Santiago Urcelay	Dean of the Faculty of Veterinary and Animal Sciences	Universidad de Chile	22 July	Santiago
Sonia Barría	Sectoral Adviser of Sectoral and international programmes Division	Chilean Agency for Economic Development	18 April	Santiago

Private Institutes, Foundations and Consortia: 5 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Luis Pichott	Director of Aquaculture Innovation Centre	Fundación Chile	6 May	Santiago
Martín Pascual	Director	National Centre for Alternative Development Studies	30 May	Santiago
Pablo Kangiser and Susana Jiménez	Legislative Researcher and Economic and Social Researcher, respectively	Libertad y Desarrollo	4 May	Santiago
Pablo Mazo	Assistant Director	Technological Salmon Institute (INTESAL)	17 May	Puerto Montt
Rodger Miranda	General	Aquainnovo	20 May	Puerto

	Manager			Montt

Interest Groups subdivided into:

NGOs: 4 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Alejandro Salinas	Director	Environmental and Labour Monitoring of Chiloé (OLACH)	31 May	Santiago
Alex Muñoz	Executive Director	OCEANA	22 June	Santiago
Flavia Liberona	Executive Director	Fundación Terram	2 May	Santiago
Juan Carlos Cárdenas	Executive Director	ECOCEANOS	20 June	Santiago

Associations: 7 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Carlos Odebret	General Manager	Association of Chilean Salmon Industry (SalmonChile)	12 May	Puerto Montt
Esteban Chamorro	President	Association of Divers (ADEB)	9 July	Castro (Chiloé)
Gustavo León	President	Association of Maritime Shipowners (ARASEMAR A.G.)	8 July	Puerto Montt
Julio Traub	President	Association of Trout and Coho Salmon Producers (ACOTRUCH)	20 May	Puerto Montt
Pablo Elvenberg	Head of	Association of	13 July	Puerto

	Control Management, Management and Projects	Maritime Shipowners (ARMASUR A.G.)		Montt
Soledad Zorzano	Technical Director	Association of Nets (ATARED)	16 May	Puerto Montt
Zoila Bustamante and Cristian Tapia	President and Lawyer, respectively	National Corporation of Fishermen (CONAPACH)	8 June	Valparaíso

Trade Unions: 2 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Francisco Rain	Former Union Leader	Trade Union FETRASAL	11 July	Puerto Montt
Ricardo Casas	Union Leader	Trade Union FETRAIMPRES	11 July	Puerto Montt

Government decision makers in this case senators and deputies: 6 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Alfonso De Urresti (Member of Parliament)	Deputy in the Natural Resources, National Assets and Environment Commission	National Congress	5 July	Valparaíso
Antonio Horvath (Member of Parliament)	Senator and President of the Maritime Interests, Fisheries and Aquaculture Commission	National Congress	20 July	Valparaíso
Carlos Recondo (Member of Parliament)	Deputy and President of Maritime Interests,	National Congress	21 June	Valparaíso

	Fisheries and Aquaculture Commission			
Enrique Accorsi (Member of Parliament)	Deputy in the Natural Resources, National Assets and Environment Commission	National Congress	5 May	Valparaíso
Jorge Ulloa (Member of Parliament)	Deputy in the Maritime Interests, Fisheries and Aquaculture Commission	National Congress	21 June	Valparaíso
PatricioVallespín (Member of Parliament)	Deputy in the Natural Resources, National Assets and Environment Commission	National Congress	7 June	Valparaíso

Producers Firms: 9 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Agustín Adasme	Technical Assistant Manager	Vetisqueros S.A.	24 May	Puerto Montt
Berta Contreras	Technical Assistant Manager	Marine Harvest Chile S.A.	26 May	Puerto Montt
Enrique Silva	Smoked Manager	DeliFish Patagonia Salmon	27 May	Puerto Montt
Felipe Sandoval	Director of Corporate Affairs	AquaChile	30 May	Santiago
Guillermo Brain	Environmental Manager	Cultivos Yadran S.A.	24 May	Puerto Montt
José Ramón Gutiérrez	Executive Director	Multiexport Food S.A.	17 June	Santiago
Mauro Araneda	Technical Manager	Pesquera Los Fiordos Ltda.	25 May	Puerto Montt
Pedro Pablo Laporte	Manager of Salmon Area	Salmones Itata S.A.	24 May	Puerto Montt

Víctor Hugo Puchi	President of the Board	Empresas AquaChile S.A.	13 June	Santiago

Suppliers Services subdivided into:

Consultants: 7 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Adolfo Alvial	Managing Director	Adolfo Alvial Asesorías	18 May	Puerto Varas
Andrea Zúñiga	Auditor and Senior Consultant	Go Up	22 May	Puerto Montt
Estrella Díaz	Researcher in the Division of Studies	Work Direction	7 June	Santiago
Francisco Mery	Project Manager	POCH Ambiental	13 May	Puerto Montt
Jorge Quiroz	Consultant	Quiroz &Asociados	4 July	Santiago
Ricardo Norambuena	Associate	GEQ Chile S.A.	26 April	Valparaíso
Rodrigo Infante	Development Manager	Gestión Ambiental Consultores	31 May	Santiago

Lawyers: 3 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Javier Ovalle	Lawyer	Ovalle y Cia	15 June	Santiago
Raúl Lecaros	Lawyer	AVL Abogados	13 June	Santiago
Ronald Schirmer	Lawyer	Legal Sur S.A.	18 May	Puerto Montt

Laboratories and Veterinarians: 4 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview

Bernd Wrege	General Manager	Pharmaq AS Chile Ltda.	15 July	Puerto Montt
Daniel Nieto	General Manager	Sustainable Salmon	17 May	Puerto Montt
Javier Moya	Sales and Services Manager	Diagnotec S.A.	7 July	Puerto Montt
Patricio Bustos	General Manager	ADL Diagnostic Chile	19 May	Puerto Montt

Transport and Product Process: 4 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Andrés Esteban	Commercial Assistant Director	CPT Empresas Marítimas S.A.	13 July	Puerto Montt
Leonardo Bravo	Plant Manager	Agroindustrial Santa Cruz	27 May	Puerto Montt
Mario Céspedes	General Manager	AquaIntegral E.I.R.L.	12 July	Puerto Montt
Rodrigo Pérez	General Manager	Kuality Harvest S.A.	15 July	Puerto Montt

Media: 2 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Gonzalo Silva	Editor	TechnoPress	12 May	Puerto Montt
Margarita Vergara	Managing Director	TechnoPress	3 May	Santiago

Universities: 8 interviews

Interviewee	Position at the time of the interview	Organisation at the time of the interview	Date of the interview	Place of the interview
Alejandro	Researcher	Universidad	15 July	Puerto

Buschmann		de Los Lagos		Montt
Carlos Vignolo	Researcher	Universidad de Chile	18 July	Santiago
Eduardo Bustos	Researcher	Universidad Arturo Prat	18 May	Puerto Montt
Jonathan Barton	Researcher	Pontificia Universidad Católica de Chile	28 April	Santiago
Jorge Katz	Researcher	Universidad de Chile	13 April	Santiago
Juan Pablo Zanlungo	Researcher	Universidad de Chile	13 July	Puerto Montt
Rodrigo Vidal	Researcher	Universidad de Santiago de Chile	20 April	Santiago
Sandra Bravo	Researcher	Universidad Austral de Chile	6 April	Santiago

Banking Sector and Financial Advisors: 4 interviews

Interviewee	**Position at the time of the interview**	**Organisation at the time of the interview**	**Date of the interview**	**Place of the interview**
Alejandro Alarcón	Academic staff	Universidad Gabriela Mistral	29 June	Santiago
Benjamín Vargas	Associate	Corporate Finance Group	17 June	Santiago
Fernando Edwards and Jorge Ovalle	Director of Corporate Finance and Corporate Finance Analyst, respectively	IMTrust	24 June	Santiago
José Mujica	Associate	Claro y Asociados	10 June	Santiago

APPENDIX B

EVOLUTION OF THE REGULATORY FRAMEWORK OF THE CHILEAN SALMON FARMING INDUSTRY

The evolution of the industry's regulatory framework has influenced its trajectory. This regulatory framework is comprised of organisations and regulations (laws, regulations, policies, rules and programmes) that regulate, supervise and control the industry. The development of this regulatory framework started formally in the late 1980s with the promulgation of the First General Law of Fishing and Aquaculture (Law N°18892). At that time the industry had already been operating for over 10 years and therefore it is possible to observe a gap between the regulatory and organisational-technological development of the industry. An historical look at the industry's regulatory framework helps to understand this co-evolution.

The regulatory framework of the Chilean salmon industry is immersed in the regulatory framework of the aquaculture sector, since the salmon industry belongs to the aquaculture sector. The aquaculture sector in Chile was developed under the fishing sector. Since 2000 the contribution of the aquaculture to total Chilean fisheries exports (capture plus aquaculture) has exceeded the contribution of the capture[61] (TechnoPress S.A., year 2000 onward).

Although aquaculture activities have been performed in the country since the 18th century, it only became a commercial activity in the 1960s with oysters and mussels culture. In the 1980s the boom of the salmon industry began, which became the major contributor to the aquaculture sector up to now (Subpesca, 2009).

1. Up to 1973:

This period covers the experimentation phase of the industry and is characterised by a lack of a specific regulatory framework for the industry. Probably the absence of a specific regulatory framework to perform salmon culture is justified by the incipient and experimental activities that were carried out at that time. However, the salmon farming activities carried out during this period as part of the fishing and aquaculture activities were regulated under the fishing regulatory framework. It is, therefore, important to understand the origins of the fishing

[61] In 2000 the contribution of aquaculture was 56.1% to the total fisheries exports (Technopress).

regulatory framework in order to understand the development of the regulatory framework of salmon culture.

The origins of the regulatory framework of the fishing sector go back to the 1930s when, through the law-ranking decree N°34 of 1931 from the Ministry of Agriculture[62],the need to legislate the fishing sector was recognised. This was because a lack of adequate information about the subsectors of the fishing sector made it difficult to make investments and policy decisions to develop it. In 1934 the decree N°1584 approved the regulation to apply the law-ranking decree N°34 of 1931 about the fishing industry and its by-products. In this regulation there were some specifications for salmon species such as close seasons, minimum size of the species to capture, buy, sell and transport and net specifications. Also, the prohibition of using salmon eggs as caviar was specified (Chilean National Congress Library, 1934).

In the 1920s, the regulation of fishing activities was under the charge of the Ministry of Agriculture, Industry and Colonisation, which was created in 1924. In 1927 this Ministry changed its name to the Ministry of Public Works whose duties were compromised to those related to the agricultural sector, which included fishing activities. This Ministry of Public Works had a Department of Agriculture, which, in 1930, became the Ministry of Agriculture (Ministerio de Agricultura, 2012). Thus, the fishing sector in Chile was developed in the agriculture sector and therefore the organisation that was in charge of fishing activities (and therefore in charge of aquaculture activities) from the beginning was the Ministry of Agriculture.

In 1964 the Ministry of Agriculture had a Direction of Agriculture and Fisheries that included a Fishery Department. In 1967 this Direction of Agriculture and Fisheries became the Agriculture and Livestock Service (SAG for its Spanish acronym), independent from the Ministry of Agriculture. Creating this new organisation it would be possible to strengthen the development of agricultural production, forestry and fishing, solving problems arising from the productive process related to, for example, plant and animal health, land and water conservation, and renewable natural resources. Also, among its tasks were those activities relating to oversight and control of compliance with norms that the Ministry of Agriculture had under its responsibility.

Related to aquaculture activities, the Agriculture and Livestock Service at this time had a bioaquatic programme to cultivate oysters and mussels, first introductions of pacific salmon

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[62] In 1983 the law-ranking decree N°5 from the Ministry of Economy, Development and Reconstruction stated the revised, coordinated and systematised text of the law-ranking decree N°34 of 1931, which legislates about the fishing industry and its by-products (Chilean National Congress Library, 1983).

and produce information about the quality of the water in lakes and rivers (Chilean National Congress Library, 1967; Servicio Agrícola y Ganadero, 2012).

Also in 1964 the Chilean Agency for Economic Development (CORFO) created the Fisheries Development Institute (IFOP for its Spanish acronym) with the aim of conducting research in fishery and aquaculture (Instituto de Fomento Pesquero, 2012). In 1976 the Chilean government set up the 'semi-public entrepreneur cum venture capitalist' organisation Fundación Chile, with the aim of transferring technology from abroad and adapting it to the Chilean conditions in order to strengthen or develop new sectors and industries for the country (Agosin, Larraín and Grau, 2009). Salmon was one of the industries developed by Fundación Chile.

In terms of regulations, in 1960 the law-ranking decree N°340 about maritime concessions was published. Although this did not refer specifically to aquaculture, it was an important decree since aquaculture requires concessions to perform its activities. This decree set up the exclusive power of the Ministry of National Defence and Maritime Undersecretary to grant the specific use of places such as beaches, land of fiscal beaches, seabed, water portions, and concessions in rocks, rivers and lakes (Chilean National Congress Library, 1960).

In 1968 decree N°223 approved the regulation to apply the law-ranking decree N°340about maritime concessions (Chilean National Congress Library, 1968). Later, this decree would be modified in 1994 by decree N°476 (Chilean National Congress Library, 1995b) and 1998 by decree N°161 (Chilean National Congress Library, 1998), and replaced in 2006 by decree N°2 (Chilean National Congress Library, 2006a), in order to update the concession regulations according to the requirements and practices in the fishing and aquaculture sectors.

In September 1973 a military coup occurred and marked the beginning of 17 years of dictatorship in Chile and the arrival of new economic reforms based on neoliberal ideas. The Junta took the direction of the country and dissolved the National Congress, assuming the legislative work that means the facility to make and announce laws. The justification to dissolve the National Congress was the need to accelerate the fulfilment of the functions and tasks the Junta proposed as pointed out in decree-law N°27 (Diario Oficial de la República de Chile, 1973).

2. 1974-1989:

This period covers the learning and the formative, industrial initiation and industrial expansion, phases of the industry (Iizuka, 2007).It is characterised by an initial development of the regulatory framework for the fishing sector, and therefore also for the aquaculture sector to which the salmon industry belongs.

The fishery sector continued to grow and in the mid-1970s the Chilean government recognised it as a substantial potential resource for the country. Arguing that at that time the public institutional structure of the sector and regulations of the sector had characteristics that made the development of fishery activities for industrial and commercial aims difficult, and that organisations related to the fishery sector were dispersed and under several Undersecretaries of the State and other departments making the operationalisation of a coherent and rational fishery policy difficult, the government acknowledged that it was necessary to improve the governance and performance of the fishery sector.

To do so, in 1976 the Undersecretary of Fishing under the authority of the Ministry of Economy, Development and Reconstruction was created. Jointly with the creation of this Undersecretary as a new organisation, the position of Undersecretary of Fishing as the person in charge of this new organisation was also created. However, no further details of this organisation were established in 1976: those specifications would come later (Chilean National Congress Library, 1976).

In the late 1970s the government recognised the need to reorganise the organisations and their functions in the fishery sector in order to facilitate and improve its development. Thus, in 1978 through the decree-law N°2442 from the Ministry of Economy, Development and Reconstruction, the government decided that this Ministry would be the organisation through which the government would set up policies to address and coordinate the activities related to fishery sector, with the aim of improving and developing it and to protect and conserve the marine resources. One of the functions set for this Ministry was to take action to protect the country’s marine resources from the introduction and propagation of diseases that could affect these resources, as well as to combat existing diseases. This Decree-law N°2442 also ordered the organisation of the activities performed by the Undersecretary of Fishing, and created the Fisheries Service and National Fishery Council.

The powers of this organisation were under the authority of the Undersecretary of Fishing. In addition, it covered the functions of the two departments this Undersecretary had at this time (Department of Resources and Department of Studies) and the staff required to perform the activities, around 50 people. The Fisheries Service was also created under the authority of the Ministry of Economy, Development and Reconstruction and it was set that this Service would implement the national fishery policy and control its fulfilment. The adequate implementation of sector regulations were duties also given to this Service.

It was established that this Service would have one national office plus regional offices. The departments of the national and regional offices were established as well as the functions of these departments. It was stated that the person in charge of this Service would be the Director of Fisheries Service and his tasks were specified. The Fisheries Service was created with 191 people. From this moment the duties in terms of the fishery activities, and therefore of aquaculture activities, performed by the Ministry of Agriculture and its departments (e.g. Agriculture and Livestock Service and Agricultural Development Institute[63]) were transferred to the Fisheries Service, and the departments related to fishery activities in those organisations were closed. On the other hand, the National Fishery Council was created as an advisory body for the Ministry of Economy, Development and Reconstruction. Its function was to advise on the coordination and safeguarding of the country's maritime interests relating to fishing (Chilean National Congress Library, 1978).

In the 1980s, the regulatory framework for the fishing and aquaculture sector was slowly being developed. In 1980, through the decree N°175, fishery activities were regulated. However, at the same time the concept of aquaculture activity was defined, and a set of concepts to perform it such as farming establishments, collection centres, seed, broodfish and fry (young fish). In particular this regulation refers to salmon culture specifying, among other issues, the requirements to begin salmon culture (e.g. the submission of an annual production plan per specie), the features of the concessions and the size of the species. In environmental and hygienic issues it regulates how and when to decontaminate the water, from where eggs, fries (young fish) and brood fish should be obtained, and that it is the Undersecretary of Fishing who may authorise in advance the import and reproduction of species. In the case of import species it was specified that a sanitary certificate was required (Chilean National Congress Library, 1980).

In 1989 the government discussed the regulatory framework of the fishing sector, pointing out the existence of a disperse set of regulations. This dispersion of regulations did not allow decisions to be made on the sector, and therefore the need to put all these regulations under

[63] Created in 1962 by the Law N°15020 (First Agrarian Reform Law) from the Development and Agricultural Research Council. This had the aim of helping small and medium farmers within the First Agrarian Reform, which was meant to improve the levels of agricultural production through the slow modification of land ownership regime by allowing the redistribution of State land among agricultural workers (Chilean National Congress Library, 1962).

one main law was recognised. With this aim the first General Law of Fishing and Aquaculture was published in December 1989 (Law N°18892 Chilean National Congress Library, 1989), with it coming into effect from 1 April 1990. This law marked an important milestone for the aquaculture sector because it is this law that created the aquaculture sector as it is from the aquaculture activities performed in the country up to that time. In this law a complete section refers to aquaculture, referring to the aquaculture concessions and the procedure that these concessions should follow. Because this law included the aquaculture sector it was called General Law of Fishing *and* Aquaculture.

3. The 1990s:

In March 1990 with the return to democracy, the National Congress was reopened in Chile. The implementation of the General Law of Fishing and Aquaculture (Law N°18892) was postponed five times[64], until August 1991, in order to discuss modifications in the Congress. Also the Laws N°19079 (Chilean National Congress Library, 1991c) and N°19080 (Chilean National Congress Library, 1991d) introduced modifications to the 1989 General Law of Fishing and Aquaculture (Law N°18892). Some specifications were related to the requirements to obtain aquaculture concessions and authorisations[65], the responsibility of concession holders, and the powers of authorities (e.g. Fisheries Service, Navy and Police) to supervise the fulfilment of the law. In terms of sanitary issues it was specified that a regulation would be announced to set measures to protect and control the prevention and introduction of high risk diseases, take measures in case of outbreak occurrence, as well as to prevent the spread and eradicate those diseases. In the same regulation which the high risk diseases would be was also specified.

However, in 1992 the decree N°430 (Chilean National Congress Library, 1992a) became the consolidated version of the 1989 General Law of Fishing and Aquaculture, which unified all the regulations and amendments in a single document. It promoted growth of aquaculture in the context of environmental sustainability and organized all fishing activities (extraction, aquaculture, research and sports) that are conducted in the country's waters. Therefore, from

[64] Laws that postponed this implementation were: Law N°18977, Law N°18999, Law N°19009, Law N°19043 and Law N°19066 (Chilean National Congress Library, 1990a, 1990b, 1990c, 1991a and 1991b). Also the Laws N°19079 (Chilean National Congress Library, 1991c).

[65] 'Aquaculture concession' refers to the rights granted by the Ministry of National Defence to use specific national goods, for an unlimited period of time, to perform aquaculture activities, whilst 'aquaculture authorisation' refers to the permission granted by Undersecretary of Fishing to perform aquaculture activities for an unlimited time in areas that are under the scope of the General Direction of Water (Chilean National Congress Library, 1991c).

this moment this document was the main normative body under which the aquaculture sector and therefore the salmon industry were developed. After 1992 a set of regulations for the aquaculture sector was created to operationalise and complement this 1992 decree N°430.

Regarding the import of hydrobiological species in 1996, the decree N°730 refers to the legal need to regulate the introduction of hydrobiological species into Chile, the studies required for this introduction, and the conditions under which imports should be made, among other issues(Chilean National Congress Library, 1996a). However, it is actually the 1996 decree N°96that specified by regulation the procedure for the introduction of hydrobiological species into the country (Chilean National Congress Library, 1996b). This regulation would be replaced in 2012 after the ISA crisis by decree N°72 (Chilean National Congress Library, 2012a).

Regarding the concessions, the 1993 decree N°550 regulated the concession areas and aquaculture authorisations in order to secure an adequate use of the water (Chilean National Congress Library, 1993b). For salmon culture the maximum limits for farming activities was set. The 1993 decree N°290 regulated the aquaculture concessions in terms of their types, procedures to obtain them, transfers and rents, holder's rights and maintenance of the ecological equilibrium, among other issues (Chilean National Congress Library, 1993a). On the other hand in 1994the National Aquaculture Register was also created by regulations (Chilean National Congress Library, 1994a). In 1995the procedure to report to the Fisheries Service the fishing and aquaculture activities was laid down (Chilean National Congress Library, 1995a). Also, since 1993, different decrees dictated by the Ministry of National Defence have set suitable areas for aquaculture to each region in the country.

In 1992 the Ministry of Economy, Development and Reconstruction modified the structure of the Undersecretary of Fishing and the Fisheries Service by the law-ranking decree N°1 (Chilean National Congress Library, 1992b). Considering that the Undersecretary of Fishing is the organisation that proposes the fishery policy and its application, and coordinates the fisheries activities from the government, and that the Fisheries Service is the organisation in charge of the implementation of the fishery policy and regulations of the sector as well as the supervision of their fulfilment, the aim of the modification of the structure of these two organisations was to ensure a more efficient performance of their activities and functions. Thus, the Undersecretary of Fishing would have an Aquaculture Department and the Fisheries Services would have a Sanitary Fisheries Department.

Another important milestone of this period was the announcement of the General Environmental Law (Law N°19300) in 1994 by the Ministry of General Secretary of the

Presidency. It established the institutional national framework to prevent and solve environmental problems and sets tools for effective management and protection of the environment. One of these tools was the Environmental Impact Assessment System (SEIA for its Spanish acronym). Since aquaculture activities could cause environmental impacts this tool applies to the aquaculture sector. Therefore the regulation on environmental impact assessment applies to the aquaculture as well. This law also specified that the activities that could cause environmental impacts, such as aquaculture, required an Environmental Impact Study if these activities produce negative environmental externalities such as the negative impacts on the renewable natural resources, of which the water is one.

4. The 2000s:

In the 2000s the regulatory framework for the aquaculture sector, and therefore for the salmon industry made important progress in the areas of sanitation, environment and plagues (i.e. sanitary and environmental areas). Also during this period (2007-2010), the salmon industry faced a sanitary crisis produced by the infectious salmon anaemia (ISA) virus, which radically changed the industry's regulatory framework.

In broader issues, in 2003the National Aquaculture Policy and the commission in charge to implement it was set by decree N°125 (Chilean National Congress Library, 2003a). The setting of this policy was based on the need to face the challenges of the aquaculture sector related to the possibility that commercial international agreements between Chile and other countries offered to develop the sector with traditional and new species, the rational use of public goods, and the protection of the country's sanitary and environmental assets. In this context there was a need to orient the actions of the public and private sector through a national policy.

Regarding sanitary regulations in 2002, the decree N°319 set the Sanitary Regulation RESA (Chilean National Congress Library, 2002). This is the regulation on preventive, control and eradication measures on high risk diseases for hydrobiological species. In this regulation the classification of high risk diseases is set out in two lists (list 1 and list 2). In list 1 contains the diseases that should be declared to the World Organisation for Animal Health, or those that were not detected in national territory, or those whose distribution is delimited to geographical zones in the country. In list 2 are the diseases that are considered as important for the World Organisation for Animal Health, or those that are distributed at length in the national territory.

According to the surveillance programmes, if there is any suspicion about the presence of the diseases specified in list 1, the farming centre holder should inform the Fisheries Services within 48 hours of the outbreak being discovered.. After this the measures specified in these programmes should be implemented. This regulation also regulates on the surveillance programmes, farming and experimental centres, transport of the species and their samples, treatments to deal with diseases, and diagnostic laboratories, among other issues. There are specifications about the introduction of high risk diseases from the import of hydrobiological species and the import of eggs, as well as the certificates required to introduce species and eggs into the country.

The Sanitary Regulation has been modified eight times, mainly after the ISA crisis. The latest version is the most complete and is dated September 2011. In this version new requirements have been introduced for the aquaculture sector after the sanitary crisis. For example, the fallowing period of farming centres, the productive cycle of species and the hygienic measures along the value chain of aquaculture have all been specified. Today, anybody who has substantiated suspicion about the outbreak of a disease should inform the authority (Fisheries Service). In addition, a third list of the disease classification was added. In this list 3 are diseases that are not considered in list 1 and list 2, and that were diagnosed in the country. These diseases are those producing variable mortality; also their complete epidemiology cannot be completely described. In this sense the possibilities of discovering diseases and dealing with them have been expanded.

Regarding environmental regulations, in 2001 the decree N°320 set the Environmental Regulation RAMA with the aim of preserving the environmental equilibrium in places where aquaculture activities are performed (Chilean National Congress Library, 2001). This regulation states that the concession holder is responsible for this environmental equilibrium, and it applies to all types of aquaculture activities. Thus, everybody performing aquaculture activities is responsible for the protection of the environment in which those activities may cause negative impacts. This regulation specifically refers to the conditions to operate farming centres, specifying that these centres should have contingency plans if their activities negatively affect the environment. Also it regulates the escape of species and the environmental information required to perform aquaculture activities.

The Environmental Regulation has been modified six times, mainly after the ISA crisis. The latest version is the most complete and is dated February 2012. This version involves, among other issues, specifications on Environmental Reports, how to clean equipment used in aquaculture and the effects of this cleanliness to the environment, the washing and cleanliness of nets, for example, it is explicit that when a net is removed it should be immediately kept in an hermetic container. The transport of nets should also be in hermetic containers. This regulation also gives specifications on the washing and cleanliness of culture equipment when it is performed on land, and gives specifications on the washing and cleanliness of culture equipment in naval artifacts such as boats and pontoons. Also it specifies when cleaning *insitu* is viable.

In 2006 the decree N°345 approved the regulation on hydrobiological plagues. The aim of this regulation was to set measures to control and prevent the introduction of species that were considered as hydrobiological plagues, as well as isolating them if they are in the country, prevent their spread and eradicate them. The regulation defined the species that are considered as hydrobiological plagues. It is understood that a hydrobiological plague is a population of an hydrobiological specie that, given its density in a territory, could cause negative effects on human health and fishing and aquaculture activities, with negative economic impacts for those activities (Chilean National Congress Library, 2006b). In 2011 (after the ISA crisis) the Undersecretary of Fishing modified this regulation, including the specification that people should declare fishing equipment when they get into the country. Also, there is a need to adopt disinfection measures of fishing equipment and boats. These measures were set on the detection of the Didymosphenia geminata microalga in the country, whose appearance is related to the introduction of fishing equipment into the country.

The sanitary crisis faced by the salmon industry between 2007 and 2010 caused fundamental changes in the industry's regulatory framework (see Chapter 6 for details). The changes in the regulatory framework are reflected in two phases. In the first phase, the Ministry of Economy through the Fisheries Service formed a panel to solve the immediate problems caused by the ISA virus. A contingency plan was designed for the industry, and several measures were proposed to stop the dissemination of the virus and high levels of fish mortality. Also in this phase the Association of Salmon Industry (SalmonChile) adopted an additional 44 measures that were focalised on the virus spread.

In the second phase a more fundamental change took place. It refers to the modification of the General Law of Fishing and Aquaculture. For this, a roundtable, which included public actors and one semi-public organisation (Fundación Chile), was created to negotiate with the different actors. In March 2009 the project law to reform the General Law of Fishing and

Aquaculture reached the Congress. However, the outcome could not be announced before 2010.

5. 2010-Onwards:

After 15 months of parliamentary process, the new General Law of Fishing and Aquaculture was published in April 2010 (Law N°20484) as the outcome of the reformation process. From this Law a set of regulations was created in order to operationalise it. Since the modification of the law was aimed at improving the sanitary and environmental framework of the salmon industry and aquaculture sector, the Sanitary Regulation (RESA) and Environmental Regulation (RAMA) were modified.

In terms of organisations the Law N°20597 created the National Aquaculture Commission in 2012. This Commission was created with the aim of advising the government in proposals and evaluations of measures and programmes required to implement the National Aquaculture Policy. Among the members of this Commission are aquaculture associations, service associations and representatives of farming centres workers; all of them were appointed by the President. Also it was pointed out by this law that from now the position of Undersecretary of Fishing changes to the position of Undersecretary of Fishing *and* Aquaculture, and he will chair this Commission. Finally it was set that the names of the Undersecretary of Fishing and Fisheries Service were changed to Undersecretary of Fishing *and Aquaculture* and Fisheries *and Aquaculture* Service respectively (Chilean National Congress Library, 2012b).

The following figures show the hierarchy of organisations and regulations for the salmon industry, and production versus regulations in the Chilean salmon industry, respectively.

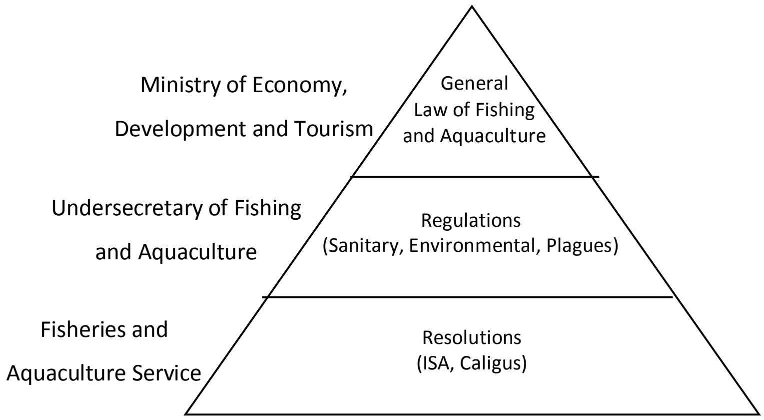

Figure B.1: Hierarchy of Organisations and Regulations for the salmon industry (and aquaculture)

Source: Own elaboration based on several regulations from the Chilean National Congress Library.

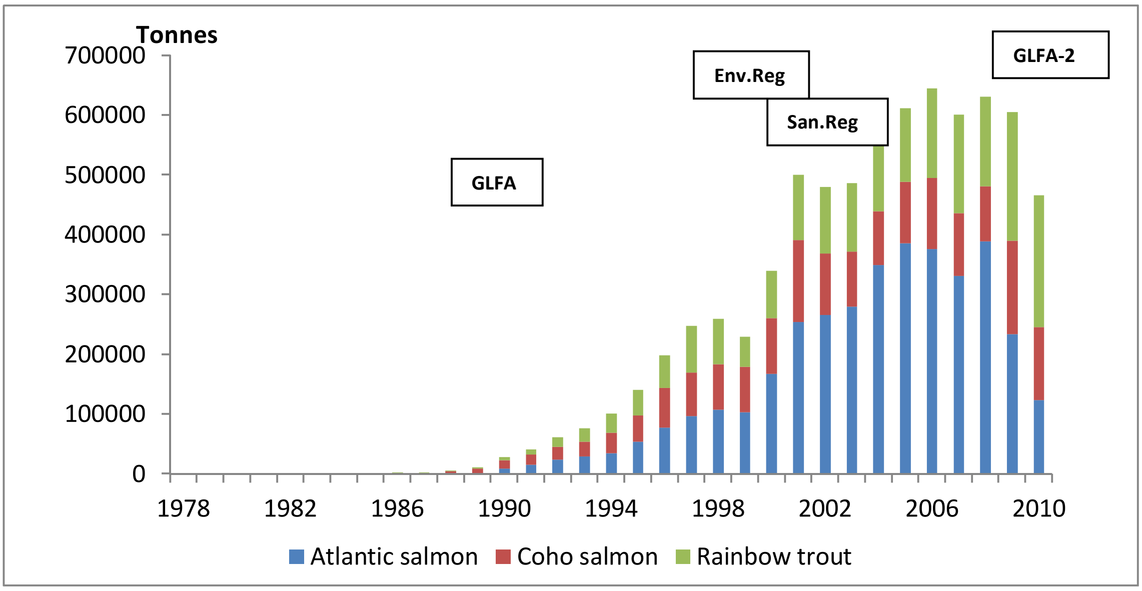

Figure B.2: Production and Regulations in the Chilean salmon industry

Note: GLFA: General Law of Fishing and Aquaculture; Env.Reg: Environmental Regulation; San.Reg: Sanitary Regulation; GLFA-2: Newly General Law of Fishing and Aquaculture.

Source: Own elaboration based on FAOSTAT and Chilean National Congress Library (1989, 2001, 2002, 2010d).